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A revision of *Begonia* sect. *Petermannia* on Sumatra, Indonesia

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Abstract

Begonia sect. *Petermannia* is revised for Sumatra, leading to the recognition of 14 species, nine of which are placed in a molecular phylogeny using nuclear ribosomal ITS data, showing they belong to two clades, intermixed with species from Java and Borneo. One new species is described, *B. kemiriensis* Girm & M.Hughes, from Gunung Kemiri, Aceh Province.

Keywords: Taxonomy, biodiversity, endemism, typification

Introduction

Begonia sect. *Petermannia* (Klotzsch 1854: 124) de Candolle (1859: 128) is one of the largest in the genus, with 432 species covering 23% of species diversity (Hughes *et al.*, 2015a). The section is characterised by protogynous, terminal inflorescences often with paired or solitary female flowers at the base, with a larger terminal cyme of male flowers, and often a cane-like or shrubby habit. Its closest ally is *Begonia* sect. *Bracteibegonia* de Candolle (1859: 127) with 13 species (Doorenbos *et al.* 1998; Thomas *et al.* 2011; Moonlight *et al.* 2018) though potentially many more species may fit better within that section than their current placement in *Begonia* sect. *Petermannia*. *Begonia* sect. *Bracteibegonia* was initially poorly defined and lacked a specimen of the type species, *Begonia bracteata* Jack (1822: 13), until 2011 (Hughes & Girmansyah 2011a). Now we can be more sure of the separation of *Begonia* sect. *Bracteibegonia* from *B.* sect. *Petermannia*, as the former has fasiculate protandrous inflorescences, conspicuous indumentum, and are usually small plants with a spreading or creeping habit.

However on Sumatra there are some species which confound these delimitations, and make sectional placement difficult. Given the large size of *Begonia* (1896 species; Hughes *et al.*, 2015a) a stable sectional framework is essential for delimiting manageable groups for taxonomic revisions (Hughes & Girmansyah 2011b). Molecular work has done little to resolve this for Sumatran *Petermannia*. Our phylogeny based on nuclear ribosomal ITS sequences presented in this paper shows clades with a mix of inflorescence types, habits and indumentums and does not highlight a clear pattern of character evolution. In addition, chloroplast data has a differing phylogenetic history to nuclear markers (Thomas *et al.* 2012; Hughes *et al.* 2018a), making a reliable sectional classification difficult. In Sumatra at least, it seems our only option is to delimit *Petermannia* by removing the species with the full suite of characters placing them in *Begonia* sect. *Bracteibegonia*, essentially leaving a group of species with a cane like erect habit, usually glabrous, with lax inflorescences. In the absence of chloroplast data for several of these species, at present we do not have enough information regarding character evolution to know if this grouping reflects phylogenetic reality or is simply a phenetic grouping. It is premature to consider merging the sections *Petermannia* and *Bracteibegonia* and creating an even larger and more polymorphic section, of even less use in facilitating identification.

The three most unusual species we include in this revision, based on their phylogenetic placement according to ITS data and their morphology are *B. divaricata*, *B. gracilicyma* and *B. vuijckii*. The first two have protandrous inflorescences with female flowers distal, and the latter is supported in a sub-clade with the type of sect. *Bracteibegonia*. The inclusion of these species permits the key to include all the cane-like species from Sumatra with glabrous stems, which is satisfying from the plant identification point of view if not quite so taxonomically. This revision covers 14 species of *Begonia* sect. *Petermannia* and allies known from Sumatra (Hughes, 2008; Hughes *et al.*, 2009; Hughes &

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Girmansyah, 2011b; Girmansyah, 2012; Hughes *et al.*, 2015b), including one new species, *B. kemiriensis*. We place nine of these species in a molecular phylogenetic context using nuclear ribosomal ITS sequences.

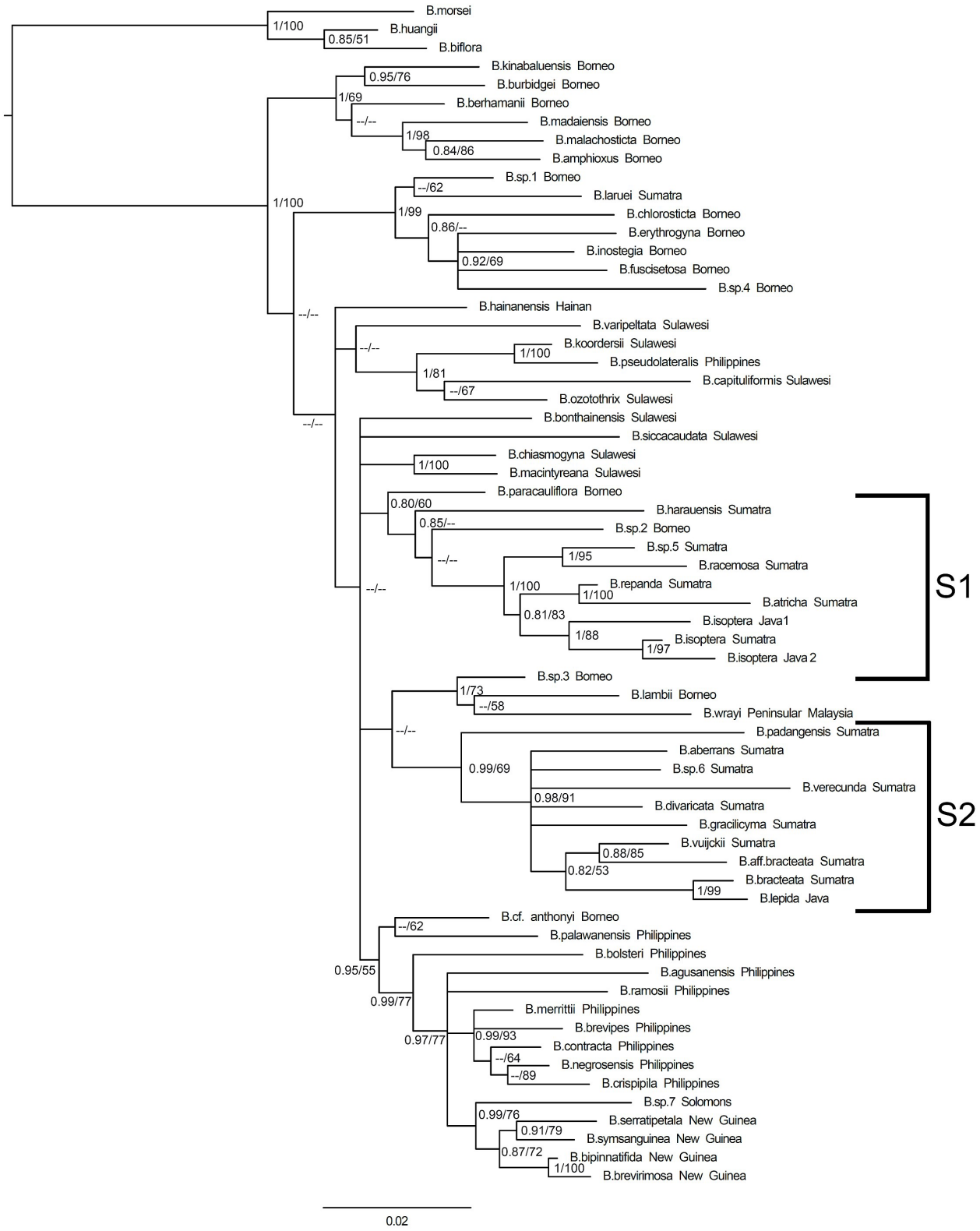

FIGURE 1. A consensus tree resulting from a Bayesian analysis of nuclear ribosomal ITS sequences. Numbers at the nodes are posterior probabilities/maximum likelihood bootstrap support values. All species from Sumatra are found in clades S1 and S2, with the exception of *B. laruei*.

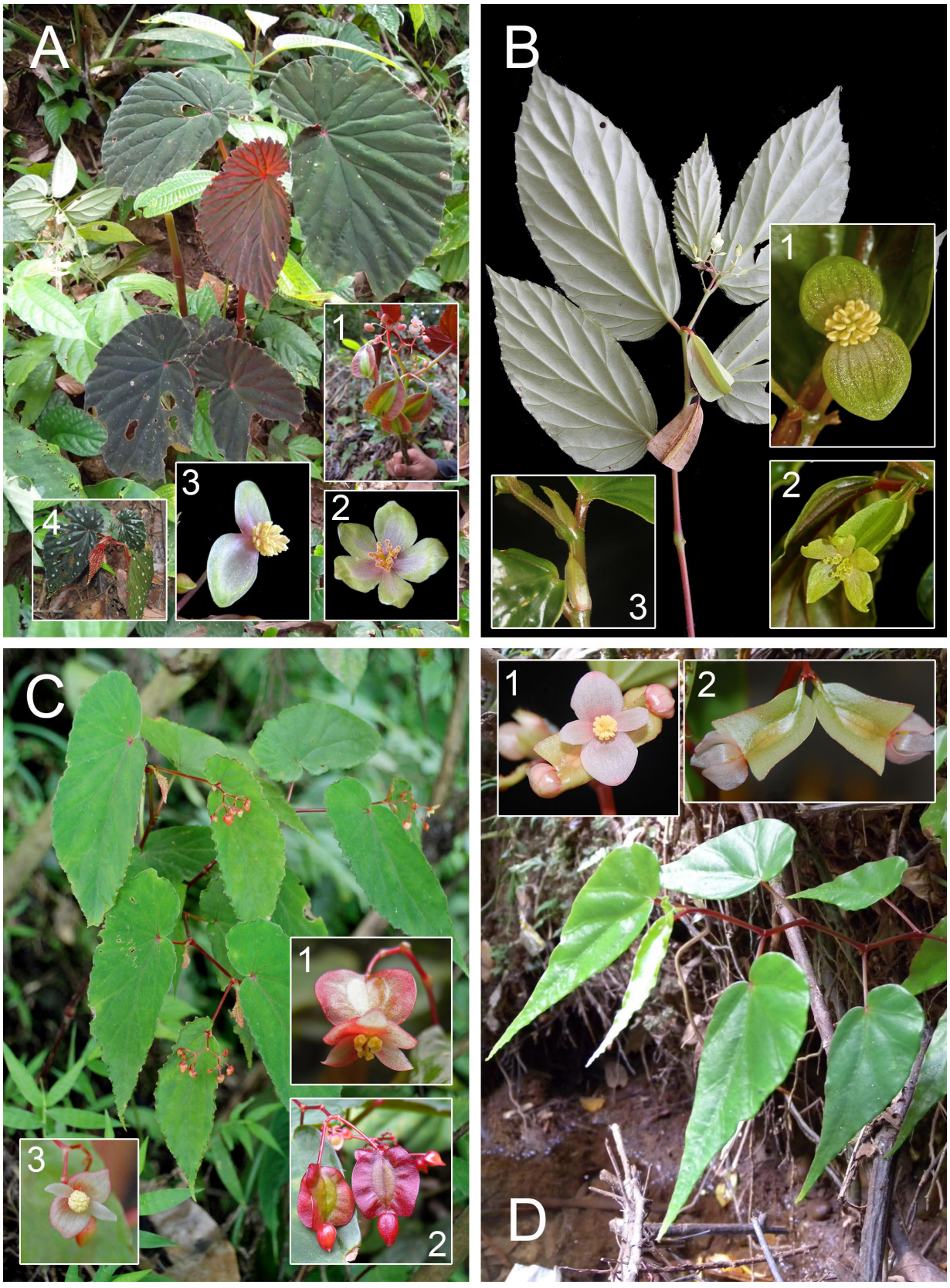

FIGURE 2. A, *Begonia atricha* (MH1543); 1, fruit (MH1543); 2, female flower; 3, male flower (flowers of a cultivated plant derived from SUBOE56); 4, young plant showing white-spotted leaf variegation (s.n.). B, *Begonia dolichocarpa* (DEDEN793); 1, male flower; 2, female flower; 3, stipules (a cultivated plant derived from PW1014). C, *Begonia gracilicyma*; 1, female flower; 2, ovary; 3, male flower (all MH1403). D, *Begonia harauensis* (MH1556); 1, male flower; 2, female flowers (flowers of cultivated plant in Bogor Botanical Garden (B200608257).

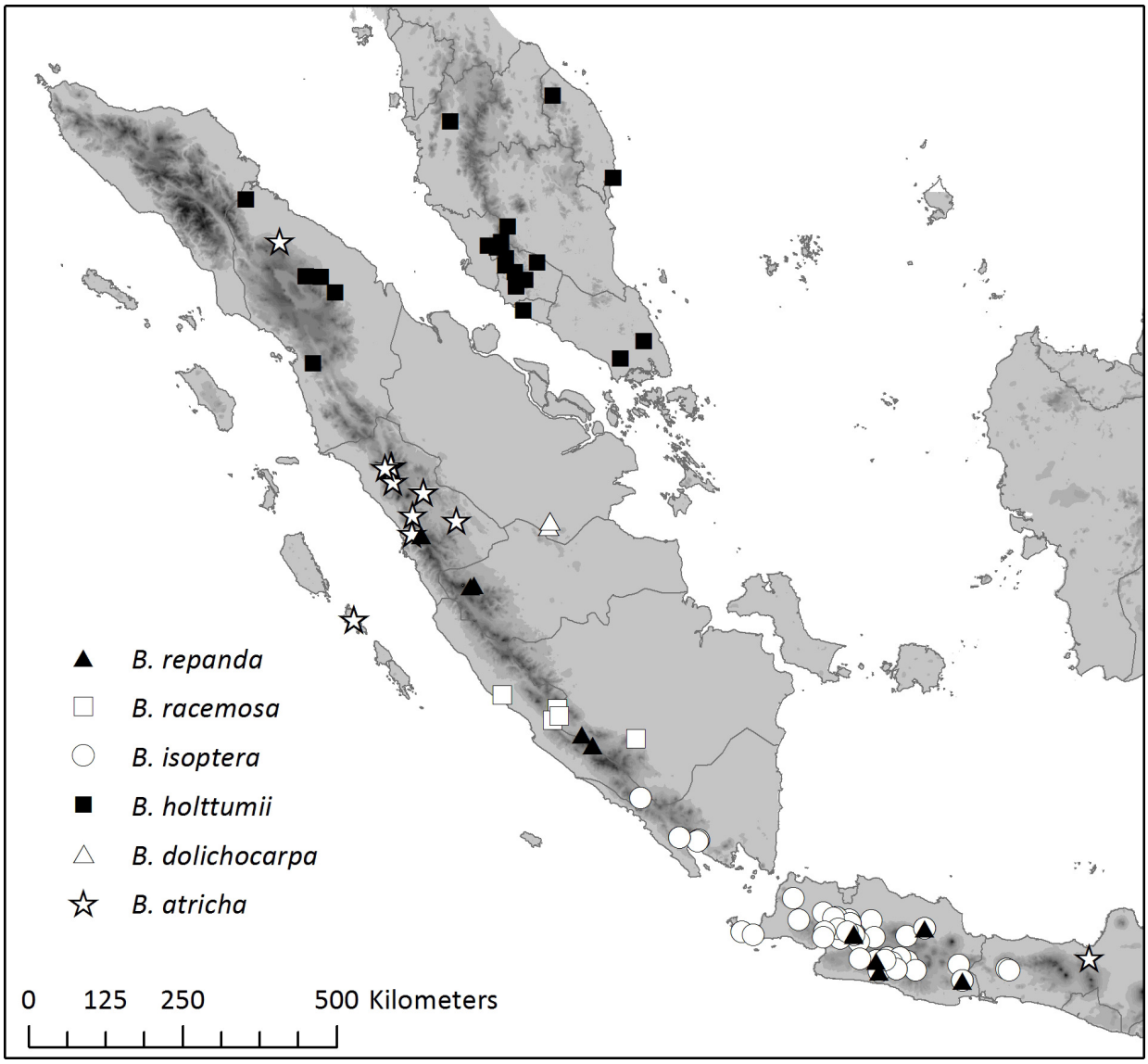

FIGURE 3. Map of Sumatra, Peninsular Malaysia and Java showing distributions of *Begonia atricha*, *B. dolichocarpa*, *B. holttumii*, *B. isoptera*, *B. repanda* and *B. racemosa* based on herbarium specimen records.

Materials and Methods

Taxon sampling

The ingroup consists of 62 samples representing 60 species of caulescent *Begonia* from Southeast Asia, focussing on *Begonia* sect. *Petermannia* and *Begonia* sect. *Bracteibegonia* from the Sunda Shelf. All available sequences from Genbank (NCBI 1988) in this group were identified by BLAST searching. The 27 samples newly sequenced for this study are highlighted with an asterisk in Appendix 1. The outgroup consists of three species in *Begonia* sect. *Coelocentrum*, based on the relationships shown in Chung *et al.* (2014).

DNA sequencing

The nuclear data set consists of the nuclear ribosomal internal transcribed spacers (ITS1 and 2) with the 5.8S gene, amplified using primers from Moller & Cronk (1997). Some samples failed to amplify sufficiently with these primers due to degraded sample DNA; these were further amplified using a nested PCR with the forward and reverse primers 51NT and 26S1Rev from Clement *et al.* (2004). The PCR product clean up and sequencing protocol follows Thomas *et al.* (2011). The fragmented nature of the sample DNA restricted this study to the ITS region, as chloroplast regions used in previous studies (e.g. Thomas *et al.*, 2011) could not be reliably amplified from the samples available.

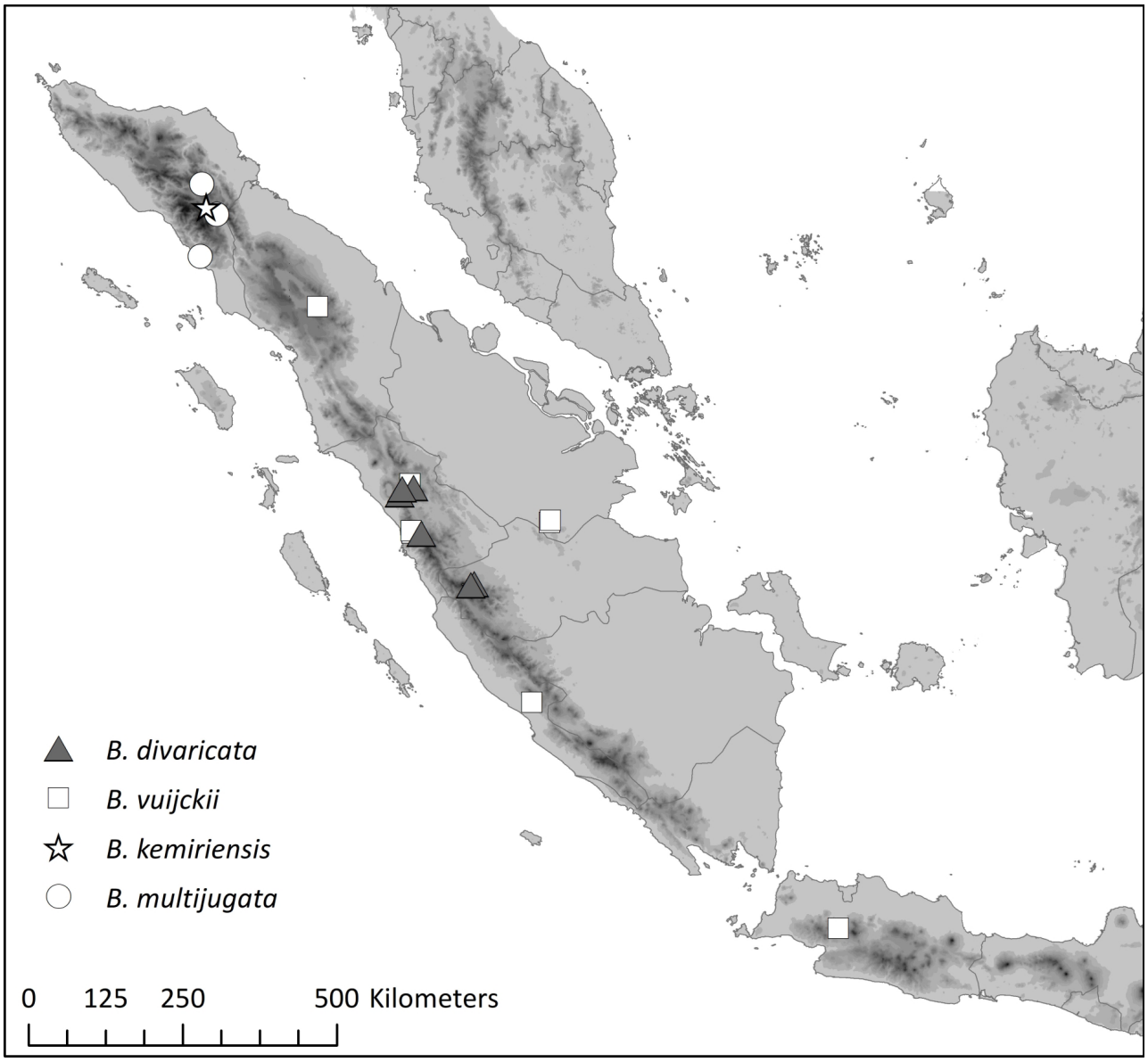

FIGURE 4. Map of Sumatra, Peninsular Malaysia and Java showing distributions of *Begonia divaricata*, *B. kemiriensis*, *B. multijugata* and *B. vuijckii* based on herbarium specimen records.

Phylogenetic analysis

Sequences were aligned manually using Bioedit (Hall 1999) and analysed using Bayesian inference with MrBayes (Ronquist *et al.* 2012), using a GTR +I +G model of sequence evolution, 50 million generations, sampling every 5000 generations and a burn-in of 25%. The alignment was also analysed using maximum likelihood with RaxML (Stamatakis *et al.* 2008) with 100 rapid bootstrap inferences followed by a thorough ML search (10 replicates), using a CAT distribution of rates.

Taxonomic revision

Six expeditions were conducted in Sumatra (annually 2007–2011 and 2016), focussing on *Begonia* habitats in the provinces Aceh, North Sumatra, West Sumatra, Bengkulu and Lampung. All available specimens of the study group from Sumatra in A, ANDA, B, BM, BO, E, FI, K, L, MICH, NY, P, S, SING and WAN (236 collections) were consulted. In addition further material of species with wider distributions in Peninsular Malaysia and Java was consulted. The measurements in the descriptions are based on dried material, and information on colours is taken from field and glasshouse observations. Images of cited specimens are available from Hughes *et al.* (2015b). Fragments of specimens taken from other sheets and mounted in the Berlin herbarium by Irmscher are designated as merotypes if they were taken from a type sheet.

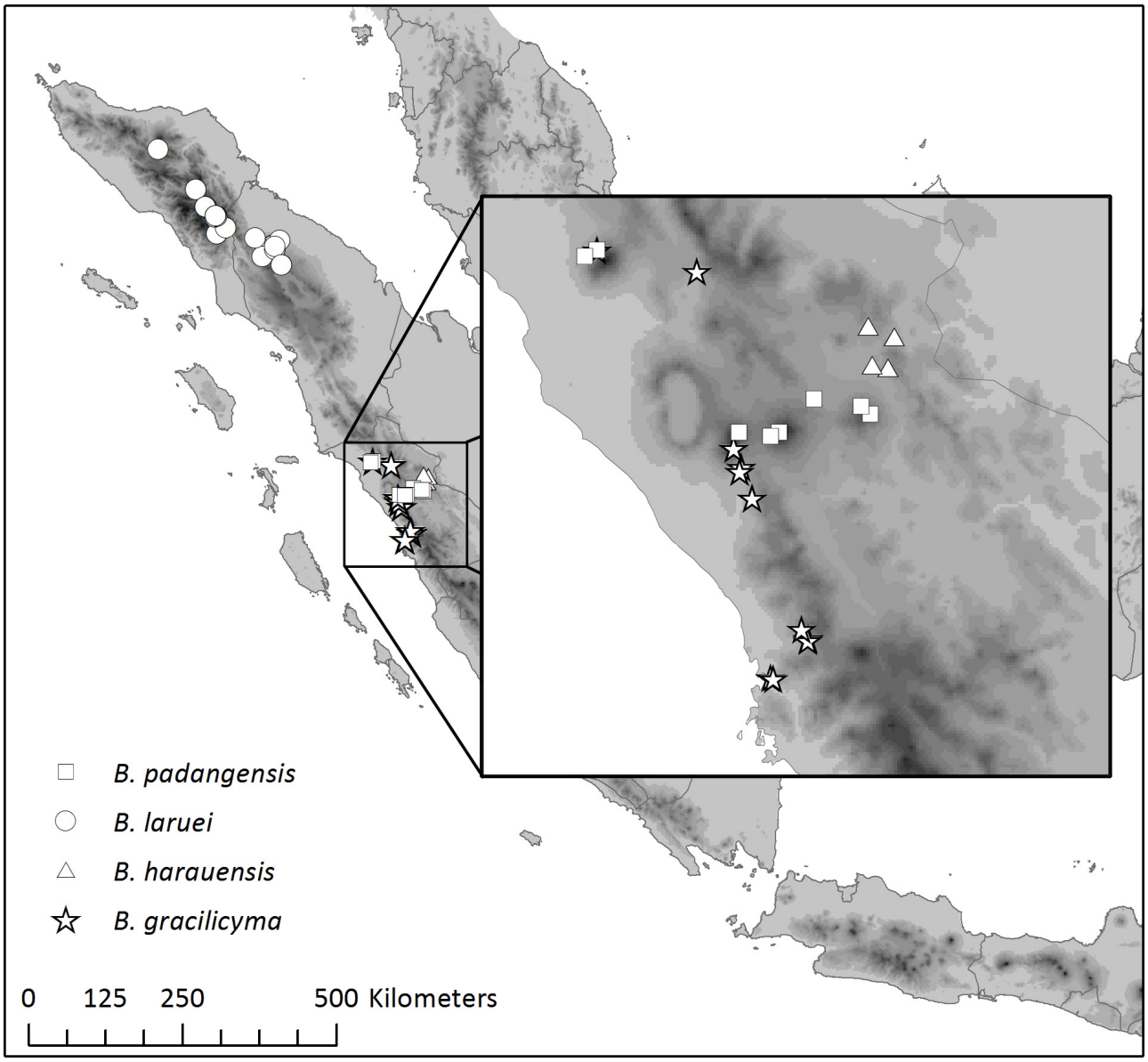

FIGURE 5. Map of Sumatra, Peninsular Malaysia and Java showing distributions of *Begonia gracilicyma*, *B. haraunensis*, *B. laruei* and *B. padangensis* based on herbarium specimen records.

Results

Phylogenetic analysis

The ingroup has poorly supported resolution at the base of the clade (Fig. 1). However there are some well supported subclades, with a strong signal of geographic clustering. Considering the Sumatran species of *Begonia* sect. *Petermannia* and allies, *Begonia laruei* is isolated in a grade of otherwise Bornean species at the base of the phylogeny, whereas the remaining Sumatran species are confined to two subclades (S1 & S2) with two species from Java and a single unidentified Bornean species. Subclade S1 contains the Sumatran species *Begonia harauensis*, *B. racemosa*, *B. repanda*, *B. atricha* and *B. isoptera*, with the latter three species also being native to Java; *Begonia* sp. 5 is discussed at the end of the manuscript under 'species incompletely known'. The Sumatran sample of *B. isoptera* (from Gunung Tanggamus in Lampung, southern Sumatra) is nested with two samples of the same species from Java. Subclade S2 contains *B. padangensis*, *B. divaricata*, *B. gracilicyma* and *B. vuijckii* from the group revised in this manuscript, along with several species of *Begonia* sect. *Bracteibegonia* which contrast markedly in habit and indumentum (*B. aberrans*, *B. verecunda*, *B. bracteata* and *B. lepida*).

Taxonomic revision

Begonia sect. *Petermannia*

Type:—*Begonia cumingiana* (Klotzsch (1854: 195)) de Candolle (1864: 320).

Erect, tall, herbs, sometime becoming woody at the stem base, stems glabrous or glabrescent. Leaves lanceolate to elliptic, glabrous or rarely with scattered hairs above, usually with a distinct petiole. Inflorescences terminal or axillary, protogynous with female flowers basal, or rarely protandrous with female flowers distal. Male flowers with 2 or 4 tepals, androecium symmetric, globose or sub-globose. Female flowers with 3 or 5 tepals, ovary with 3 equal or subequal wings and bifid placentae. Fruit on a dangling or stiff pedicel.

Key to species of *Begonia* sect. *Petermannia* from Sumatra

1	Petioles tuberculose-tomentose	*B. padangensis*
–	Petioles glabrous	2
2a.	Leaf lamina with rows of bristles between the veins on the upper surface	*B. vuijckii*
–	Leaf lamina glabrous above	3
3	Leaf with several sharply pointed lobes	*B. laruei*
–	Leaf not lobed	4
4	Inflorescences arising at the base of a shortened petiole, appearing to have a subtending leaf, female flowers distal	5
–	Inflorescences without a subtending leaf on a shortened petiole, female flowers basal	6
5	Leaf margin dentate-denticulate, upper surface glossy, flowers white, 1300–1800(–2300) m.	*B. divaricata*
–	Leaf margin entire or sparsely dentate, upper surface matt, flowers pink, 30–600(–1200) m.	*B. gracilicyma*
6	Lamina elongate-lanceolate, apex long acuminate, margin entire to shallowly undulate	*B. harauensis*
–	Lamina ovate or lanceolate, apex acuminate or shortly acuminate, margin dentate to shallowly dentate or denticulate	7
7	Fruit pedicel dangling, > 2cm long	8
–	Fruit pedicel stiff, < 2 cm long	9
8	Fruit bell-shaped, leaves 6–15 cm wide	*B. atricha*
–	Fruit suborbicular, leaves < 6 cm wide	*B. repanda*
9	Fruits borne in clusters of up to 5 pairs, fruit wings < 3mm wide	*B. multijugata*
–	Fruits borne singly or in pairs, fruit wings > 3 mm wide	10
10	Locule distinctly long and narrow, ca. 4 × 0.5 cm	*B. dolichocarpa*
–	Locule not distinctly long and narrow, less than 2 cm long	11
11	Male flowers with 4 tepals, female flowers with 5 tepals, leaves ovate	12
–	Male flowers with 2 tepals, female flowers with 3 tepals, leaves oblong-lanceolate	13
12	Leaf margin denticulate, capsule sub-globose	*B. kemiriensis*
–	Leaf margin dentate, capsule ellipsoid	*B. holttumii*
13	Ovary elliptic in outline, veins on lamina sunken above	*B. racemosa*
–	Ovary triangular in outline, veins on lamina raised above	*B. isoptera*

1. ***Begonia atricha*** (Miq.) (de Candolle 1864: 321). *Diploclinium atrichum* (Miquel 1856: 1091).

Type:—INDONESIA. Sumatra: Palembajan, *s.d.*, *J.E. Teijsmann 1100* (lectotype L [L0625695] designated here; merotype B). Fig. 2A.

Erect caulescent glabrous herb 50–150 cm tall. **Stem** 15–20 mm diameter at base when mature, becoming woody and hollow, slender and fleshy toward the apex, with adventitious roots appearing from lower repent portions; internodes 5–15 cm apart, swollen. **Stipules** caducous, up to 25 × 10 mm, keeled, reddish-translucent, acumen extending for ca. 3 mm. **Leaves**: petioles 2.5–8 cm long, with a shallow channel adaxially, green or red; lamina basifixed, thin and succulent, lanceolate on younger plants, becoming ovate and larger on more mature ones, strongly asymmetric, 14–25 × 6–15 cm, basal lobe up to 8 cm long, lobes overlapping, venation palmate-pinnate, main veins 7–11 in number; margin dentate-denticulate, with larger teeth at the end of the main veins and smaller teeth in between, appearing scalloped on larger leaves. **Inflorescences** terminal, protogynous, female flowers borne in pairs below the males, sometimes on separate peduncles, the male part elongate cymose, 5–15 cm long. **Male flowers** 10–30 in number, with 2 tepals, tepals broadly ovate-orbicular, glabrous, ca. 5 × 4 mm, entire, pale pink or pale coral pink; androecium with ca. 50 stamens, yellow-orange, sessile, slightly flattened horizontally; filaments unequal, 0.25–0.75mm, outer ones shortest; anthers oblong, 0.75 mm long, dehiscing through slits half the length of the anther, slits unilateral, apex retuse; Female flowers: pedicel ca. 25 mm, glabrous; ovary bell-shaped, 20 × 16 mm in total, locules ellipsoid, wings rounded at apex; tepals 5, subequal, 15–20 × 8–11 mm, very pale pink, greenish towards the margin; styles 3, orange-pink, Y-shaped, stigmatic surface darker, twice spirally twisted. **Fruits** large, bell shaped, pendant, borne on slender 3 cm pedicels; capsule elliptic ovate, 20 ×12 mm, 3 locular, placentae bifid; wings 3, 3.5 cm from base to apex, extending along the pedicel for 8 mm, 10–12 mm wide, rounded.

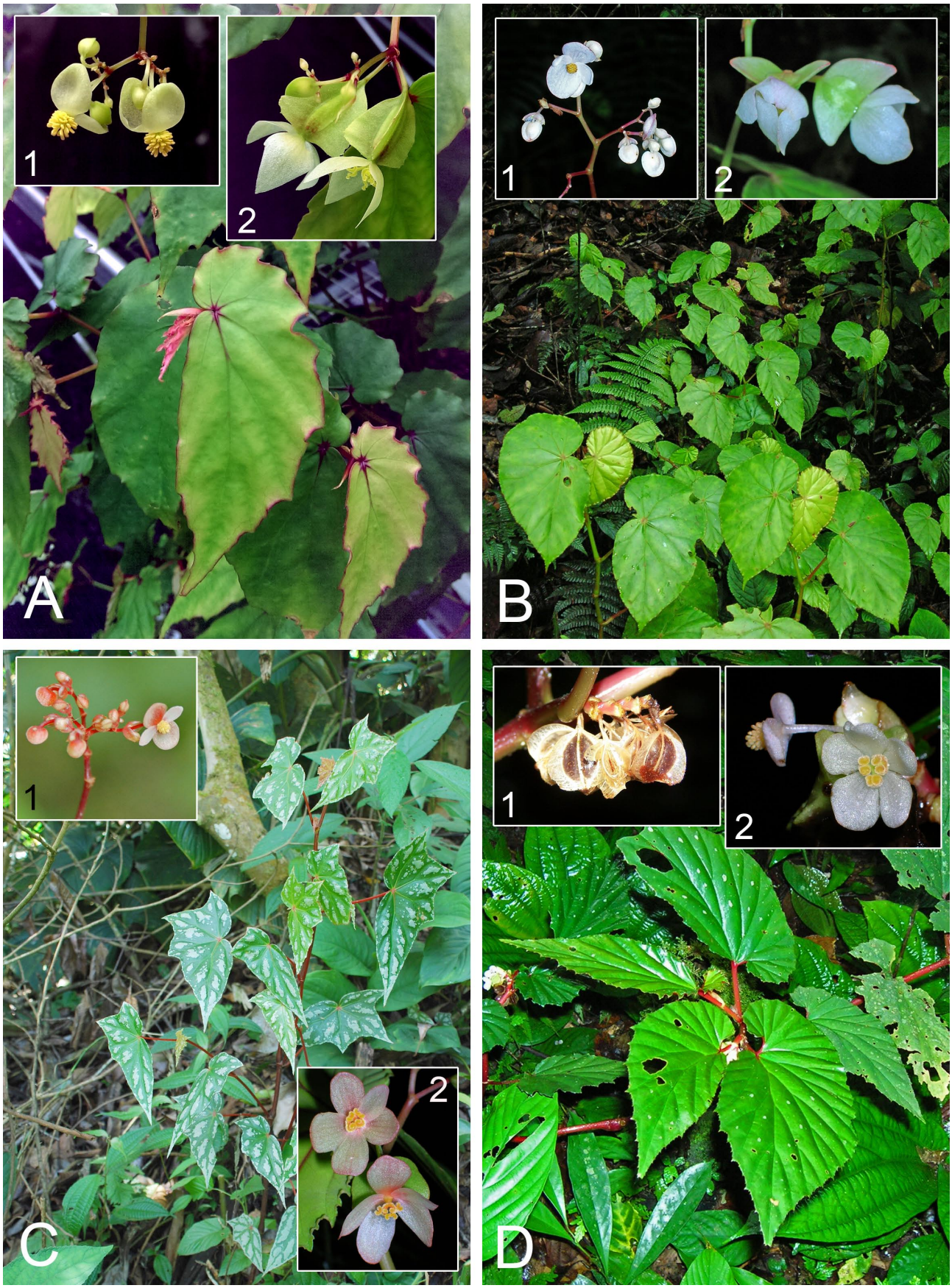

FIGURE 6. A, *Begonia isoptera*; 1 male flowers; 2, female flowers (cultivated plant derived from SUBOE74). B. *Begonia kemiriensis*; 1, male part of the inflorescence; 2, female flowers (PW692). C, *Begonia laruei* (MH1389); 1, male part of the inflorescence (MH1398); 2, female flowers (PW612). D. *Begonia multijugata*; 1, fruits; 2, male and female flower (PW768).

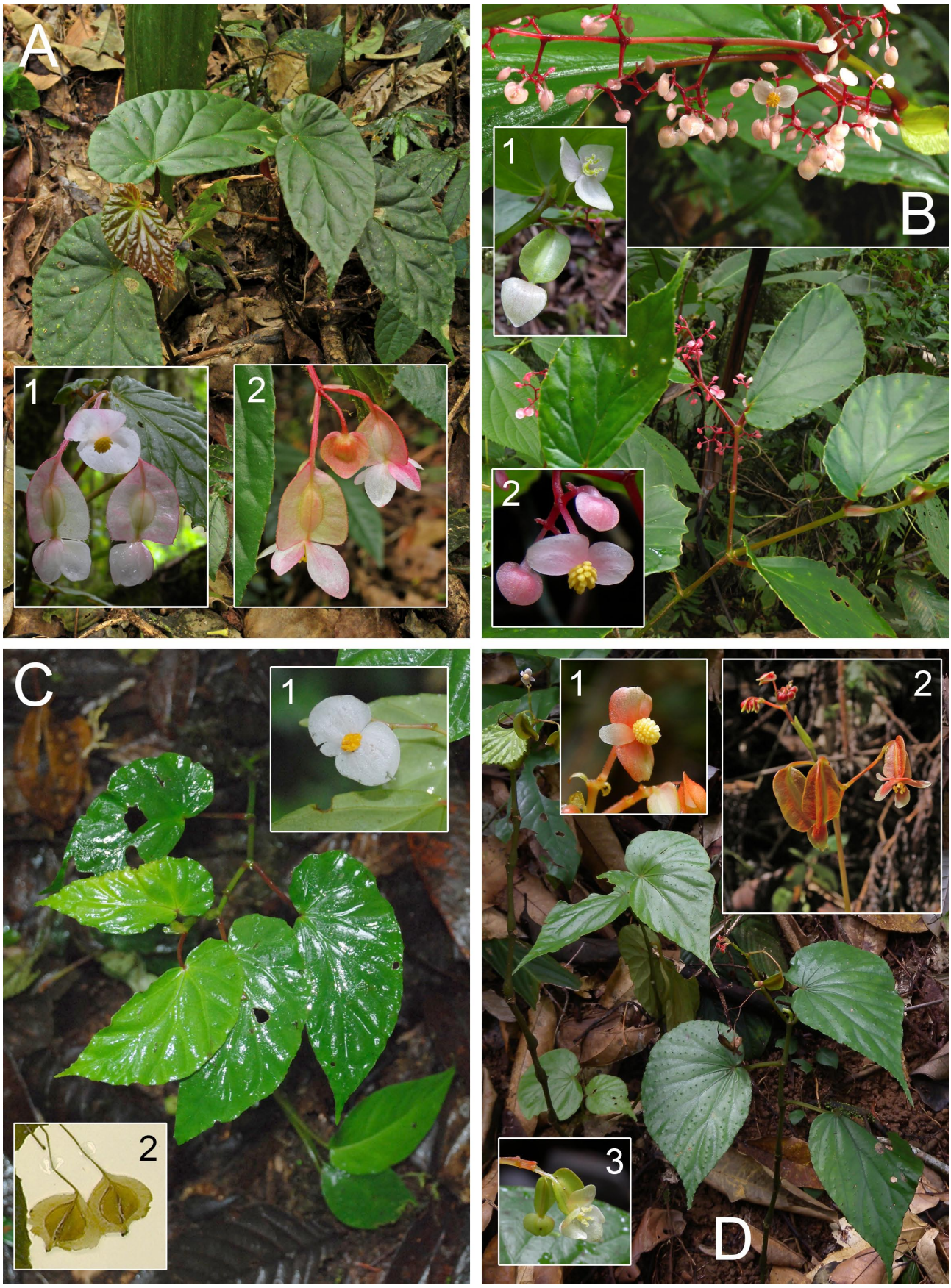

FIGURE 7. A, *Begonia padangensis*; 1 & 2, inflorescences with 1 male flower and 2 female flowers (MH1564). B, *Begonia racemosa*; 1, female flowers, 2 male flower (DEDEN1509). C, *Begonia repanda*; 1, male flower (MH1429); 2, fruits (van Steenis 17599). D. *Begonia vuijckii*; 1, male flower; 2, inflorescence; 3, female flower (CP141).

Distribution:—Java and Sumatra (most commonly encountered in West Sumatra), terrestrial in lowland to mid-montane rainforest from 100–700(–1200) m altitude. Fig. 3.

Conservation assessment:—Least concern (LC). Widespread in Sumatra and Java, including some records from secondary forest.

Notes:—It is very beautiful species with several leaf colour variants from green to dark purple underneath, and green to blackish-green above, often with white spots on juvenile plants. It can be recognised by its large bell-shaped fruit, which tapers gradually towards a very thin pedicel.

Additional specimens examined:—INDONESIA. Sumatra: **Bengkulu**: Soeban Ajam, 7 Jul 1916, *Ajoeb 301* (BO). **West Sumatra**: Bukit Gagoan, 22 June 2011, *Puglisi et al. CP105* (BO, E); Bukit Sebelah, 22 July 2009, *Hughes & Taufiq MH1543* (BO, E); Fort de Kock (Bukitinggi), 1 September 1929, *Jacobson 43* (BO); Mentawai Islands: Sipora Island, 9 October 1924, *Kloss 14653* (BO, K); Mentawai Islands: Sipora Island, 14 October 1924, *Iboet 381* (BO); Pajakumbuh, Mt. Sago, 18 May 1957, *Meijer 5816* (L); Pajakumbuh, Mt. Sago, 30 September 1956, *Meijer 8336* (L); Pajakumbuh, Mt. Sago, 7 April 1983, *Danimihardja 2331* (BO, L); Palembajan, *Teijsmann 1100* (B, L); Rimbo Panti National Park, 29 May 2007, *Hughes & Girmansyah MH1418* (BO, E); Road to Padang, 29 May 2007, *Hughes & Girmansyah MH1422* (BO, E); Road to Rimbo Panti, 27 May 2007, *Hughes & Girmansyah MH1406* (BO, E); Taman Hutan Raya, Ladang Padi, 18 December 2004 - 19 December 2004, *Nelvita 9* (ANDA); River at foot of Gunung Sago, 31 Jan 2016, *Hughes et al. SUBOE56* (BO, E); Kayu Tanam, 27 Jan 2016, *Hughes et al. SUBOE11* (BO[2], E); Kayu Tanam, 27 Jan 2016, *Hughes et al. SUBOE4* (BO[2], E); Muko-Muko, upper side of Maninjau Lake, 8 Jun 2004, *Girmansyah DEDEN391*(BO[5]); Maninjau Lake, Kanagarian Maninjau, Tanjung Raya, 8 Jul 2009, *Girmansyah DEDEN1306* (BO[2]); Bt. Kaboen, Lubuk Sikaping, 22 Jan 1918, *Biinnemeijer 1233* (BO). **North Sumatra**: Sibolangit, 5 Aug 1917, *Lorzing 5237* (BO[2], L); *s.l.*, 23 Sep 1927, *Lorzing 12465* (BO).

2. *Begonia divaricata* (Irmscher 1953: 473).

Type:—INDONESIA. West Sumatra: Gunung Singalang, vi-vii 1878, *Beccari 4505* [FI008007] (lectotype FI designated here; merotype B[2]).

Begonia divaricata f. minor (Irmscher 1953: 475) ***syn. nov.*** Type:—INDONESIA. Sumatra, West Sumatra, Gunung Singalang, vi-vii 1878, *Beccari 4507A* (lectotype FI designated here).

Erect herb to 1 m tall. **Stem** glabrous, much branched, becoming woody, slender, internodes 1.5–12 cm long. **Stipules** elongate-lanceolate, 10 × 3 mm, glabrous, acuminate, entire, deciduous. **Leaves**: petiole 1–3 cm, glabrous; lamina oblong-lanceolate, asymmetric, basifixed, cordate at the base, lobes not overlapping, 8–13 × 2–6 cm, drying very thin and papery, midrib 7–11 cm, glabrous above, with sparse minute hairs on the veins below, venation palmate-pinnate, margin dentate-denticulate with hairs at the end of the teeth. **Inflorescences** terminal, bisexual, protandrous, cymose, female flowers distal, total length 2–5 cm, primary peduncle 1.5–2.5 cm; bracts linear, entire, glabrous, 3–9 mm long. **Male flowers**: pedicel 10–15 mm, glabrous; tepals 4, glabrous, white, outer 2 broadly ovate, 7 × 5–6 mm, inner 2 elliptic, 5 × 3 mm; androecium symmetric, yellow; stamens ca. 35, filaments ca. 1.5 mm long, anthers obovoid, slits half the length of the anther. **Female flowers**: pedicel ca. 5 mm, glabrous, 2 linear bracteoles sometimes present, 4 mm long; ovary obovate-orbicular, with 3 equal wings, glabrous, total size 10–15 × 5–8 mm, capsule ellipsoid, 9 × 3 mm, placentae bifid; tepals 5, white, broadly ovate, ca. 3 × 3 mm, styles 3, pale yellow, shallowly Y-shaped, almost capitate. **Fruit** pendulous on a fine hair like pedicel, rounded-triangular in outline, total size ca. 15 × 12 mm.

Distribution:—Endemic to Sumatra in montane forest on Gunung Singgalan, Gunung Talang and Gunung Tujuh at altitudes of 1300–1800(–2300) m. Fig. 4.

Conservation assessment:—Least Concern. Gunung Singgalan and Gunung Tujuh are in protected areas.

Notes:—Irmscher (1953) noted the inflorescence structure of this species was aberrant for section *Petermannia*, lacking basal female flowers, and instead having a protandrous inflorescence with female flowers appearing distally. However molecular data places *B. divaricata* well within the section (Fig. 1). We consider the leaf size variation of *Begonia divaricata f. minor* to fall within the range of the type variety, and synonymise it here.

Additional specimens examined:—INDONESIA. Sumatra. **West Sumatra**: Bukik Bulek, 19 Apr 2003, ANDA collectors 43 & 44 (ANDA); Gunung Singgalang, vi-vii 1878, *Beccari 4506*; G. Singgalang, 27 May 1918, *Bunnemeijer 2632* (BO); G. Talang, 31 May 2007, *Hughes & Girmansyah MH1430* (BO, E); G. Talang, 31 May 2007, *Hughes & Girmansyah MH1427* (BO[3], E); G. Singgalang, 28 May 1918, *Bunnemeijer 2661* (BO); Mt. Singgalang, 13 Feb 1998, *Hoover & Hunter 858* (BO[4]). **Jambi**: Gunung Tujuh, 17 Jan 1995, *Arbain & Tamin 4199* (ANDA); Mt. Tujuh, 6 Jun 2004, Girmansyah *388* (BO[3]); Gunung Tujuh, 26 Jul 2006, *Girmansyah et al. DEDEN785* (BO, E); Mt. Tujuh, 29 Mar 2016, *Girmansyah DEDEN2291* (BO[2]).

3. *Begonia dolichocarpa* Girmansyah (2012: 231).

Type:—INDONESIA. Sumatra, Riau: Bukit Tiga Puluh, 30 vii 2006, *Girmansyah et al.* 793 (holotype BO; isotype ANDA, E[2 E00260940, E00237187]). Fig. 2B.

Erect herb to ca. 100 cm tall. **Stem** erect, rhizomatous at the base, reddish brown and pale green at the nodes, succulent, little branched, terete, glabrous, internodes in the erect stem 2–15 cm apart, without a tuber. **Stipules** reddish green, ovate to narrowly triangular, glabrous, ca. 1.4 × 0.3 cm, tip pointed, caducous. **Leaves** distant; petiole reddish brown to dark red, 1–2 cm long; lamina elliptic to oblong, dark green above, pale green to dark red beneath, base rounded on the broader side, acute on the other side, margin sparsely minutely toothed, apex acuminate, 11–19 × 5–8 cm; venation palmate pinnate, 1 pair of veins at the base and 2 3 pairs along the midrib. **Inflorescences** of male and female axillary, male inflorescence cymose, erect, shorter than the leaves, peduncles reddish, glabrous, male flowers many, female flower solitary, axillary, ovary and tepal unknown. **Male flowers** with a white pedicel 0.5–0.7 cm long; tepals 2, white, greenish near the apex, glabrous, margin serrate, tip acute to acuminate, 0.8–0.9 × 0.4–0.5 cm; androecium with 20 stamens, cluster connate, yellow, filaments 0.1–0.3 cm; anthers golden yellow, broadly triangular to narrowly obovate, ca 0.4 mm long, tip slightly notched, opening by slits the full length of the anther, slits unifacial. **Female flowers** unknown. **Fruit** with pedicel 1.5 cm long, green when young, becoming brown when ripe, elongate triangular, ca. 4 × 0.5 cm locular part without wings and the total fruit ca. 4 × 2 cm including the wings.

Distribution:—Endemic to lowland rainforest in Bukit Tigapuluh National Park, growing on river banks at altitudes of 100–200 metres. Fig. 3.

Conservation assessment:—Least Concern. Although a narrow endemic, the entire range of the species is encompassed by the Bukit Tigapuluh National Park.

Additional specimens examined:—INDONESIA. Sumatra. **Riau**: Tigapulu Mts, 2 Dec 1988, *Burley et. al. 1796* (A, L); Bukit Tigapuluh National Park, Camp Granit, 29 Jan 2016*, Wilkie et al. PW1016* (BO, E); Bukit Tiga Puluh National Park: Camp Granit, 1 Feb 2016, *Wilkie et al PW1037* (BO [2]).

4. *Begonia gracilicyma* Irmsch. ex Hughes *et al.* (2009: 30)

Type:—INDONESIA. Sumatra, West Sumatra: Padang, Ajer Mantjoer, *Beccari* PS610 (holotype, FI; isotype, B, FI, K, L). Fig. 2C.

Erect, branching herb, to 70 cm high. **Stem** woody, especially at base, glabrous, ca 5 mm wide, internodes 5–10 cm apart. **Stipules** lanceolate, 10–12 × 3 mm, glabrous, with a filiform extension at the tip, deciduous. **Leaves** alternate; petiole 1.5–5 cm long, glabrous; lamina elongate-lanceolate, strongly asymmetric, basifixed, cordate at base, lobes not overlapping, one lobe much larger giving an angular appearance, 10–18 × 2.5–5.5 cm, midrib 8–13 cm long, venation palmate-pinnate, upper surface matt green, glabrous; underside pale green sometimes marked with red, glabrous; margin glabrous, denticulate; apex acuminate. **Inflorescence** appearing adnate on the petioles, protandrous, bisexual; bracts 1–3 mm long, margin entire, deciduous. **Male flowers**: pedicel 5 mm, glabrous; tepals 4, outer tepals orbicular, white with a reddish tinge on the reverse, glabrous, ca 4 mm in diameter, margin entire; inner tepals oblong-obovate, white, 4 × 2 mm; androecium yellow, symmetric; stamens ca 30; filaments slightly fused at base, 0.75 mm long; anther about as long as the filament, dehiscing through slits about half the length of the anther, hooded, connective not extended. **Female flowers**: pedicel 10 mm long; ovary 3 locular, with three equal wings, placentae entire; tepals 5, pale green, 5 mm long, margin entire; stigma with three styles joined at the base, U-shaped, persistent. **Fruit** brown, dehiscent, pendulous on a hair-like pedicel when dry, rounded at base, truncate to retuse at the apex; wings extending along the pedicel, equal, 14 × 5 mm; capsule shape oval, length 8–9 mm, width 5 mm.

Distribution:—Endemic to lowland and mid-montane forests in West Sumatra at altitudes of 30–600(–1200) metres. Fig. 5.

Conservation assessment:—Least Concern. Most populations are on the margins of protected areas, given the distribution of this species encompasses some fairly low altitude areas. However it can be found in secondary forest and is commonly encountered and collected.

Notes:—This species has a similar inflorescence structure to *B. divaricata*, with female flowers distal. The two species may be altitudinal vicariants, with similar distributions which do not overlap altitudinally (30–600(–1200) m for *B. gracilicyma* versus 1300–1800(–2300) metres for *B. divaricata*). Although closely related they have some genetic distance between them (Fig. 1), and in the field and herbarium can be separated quite easily by the characters in the key; *B. gracilicyma* also has longer leaves with a more elongate shape.

Additional specimens examined:—INDONESIA. Sumatra: **West Sumatra**: Cindakir, Bungtekab, 30 Apr 04, *Girmansyah DEDEN380* (BO); G. Gadut, Batu Gambir, about 20 km E from Padang City, 15 Dec 87, *Okada 4625*

(BO); Ladang Padi, 18 km E of Padang, 19 Feb 04, *Girmansyah et al. 3* (BO); Ladang Padi, 22 May 07, *Hughes & Girmansyah MH1403* (BO[2]); Lembah Anai, 23 Dec 83, *Rahayu & Maskuri 4*58 (BO); Muko Muko, beside Maninjau Lake, 08 Jun 04, *Girmansyah DEDEN392* (BO[5]); Sipisang 20 km east from Padang, Air Anak Alahan Panjang, 24 Feb 96, *Okada et al 6203* (BO); Ulu Gadut, upper Gajahbuih plo,t 27 May 09, *Sumadijaya & Fanani 3* (BO); W Helling Talamau, 24 Apr 18, *Bunnemeijer 372* (BO[2]); W. Helling Talamau, 1918, *Biinnemeijer 481* (BO); Anai Nature Reserve, 9 Nov 1991, *Anda collectors 25* (ANDA); *ibid*., 9 Nov 1991, *Anda collectors 37* (ANDA); *ibid*., 12K SW of Padang Pajang, 21 Mar 1990, *Anda collectors 90* (ANDA); *ibid*., 23 Dec 1983, *Niniek & Wardi 458* (BO); *ibid*., 23 Dec 1983, *Rahayu 458* (K); Anak Air Ambacang Badak, 20K E of Padang, 15 Aug 1995, *Okada 2004* (ANDA); Bt. Batu Bajolang, 15 km E of Padang, 12 Jan 1983, *Hotta et. al. 1326* (A, L); Bukit Batu Bajolang, 15K E of Padang city, 12 Jan 1983, Hotta et. al. 1320 (ANDA); Bukit Gambir, 15 Dec 1987, Okada 4625 (ANDA); Bukit Tambun Tulang, 50K N of Padang city, 7 Nov 1998, *Anda collectors 15* (ANDA[2]); *ibid*., 50K N of Padang city, May 2006, *Anda collectors 17* (ANDA); *ibid*., 50 K N of Padang city, 8 Nov 1998, *Anda collectors 18* (ANDA); *ibid*., 50K N of Padang city, 8 Nov 1998, *Anda collectors 23* (ANDA); *ibid*., 12K W of Padang Pajang, 28 Mar 1987, *Anda collectors 24* (ANDA); *ibid*., 50K N of Padang city, 8 Nov 1998, *Anda collectors 42* (ANDA); *ibid*., 64K from Padang city, 26 May 1991, *Anda collectors 45* (ANDA); *ibid*., 14K S of Padang City, 10 Nov 1991, *Anda collectors 47* (ANDA); Bungus, 20 June 2002, Anda collectors 34 (ANDA); Bungus, Cindakir, 25 May 2002, Anda collectors 35 (ANDA); Desa Sipisang, 21K S of Padang Panjang city, 19 Dec 1992, *Anda collectors 21* (ANDA); *ibid*., 21K S of Padang Panjang city, 19 Dec 1992, *Anda collectors 25* (ANDA); *ibid*., 21K S from Padang Pajang City, 19 Dec 1992, *Syofyan et. al. 31* (ANDA); *ibid*., 55K N of Padang, 5 Apr 1997, *Anda collectors 35* (ANDA); *ibid*., 55K N of Padang, 5 Apr 1997, *Anda collectors 41* (ANDA); *ibid*., 17 Aug 1995, *Anda collectors 503* (ANDA); *ibid*., 55K N of Padang, 6 Apr 1997, *Anda collectors 23B* (ANDA); Gunung Gadut, 20K E of Padang city, 15 Dec 1987, *Okada 4629* (ANDA); Jambi: G. Kerintji, 15 Mar 20, *Bunnemeijer 8870* (BO); Kabupaten Padang Pisang, 27 Nov 1994, *Anda collectors 5* (ANDA); Kabupaten Padang Pisang, 55K N of Padang City, 27 Nov 1994, *Anda collectors 10* (ANDA); Ladang Padi, 19 Feb 2004, *Girmansyah et. al. 3* (BO, E); *ibid*., 24 May 2003, *Anda collectors 23* (ANDA); *ibid*., 24 May 2003, *Anda collectors 27* (ANDA); *ibid*., 4 May 2002, *Anda collectors 27* (ANDA); *ibid*., 14 Jun 1998, *Anda collectors 29* (ANDA); *ibid*., 16 May 1993, *Anda collectors 38* (ANDA); *ibid*., 4 May 1998 5 May 1998, *Anda collectors 46* (ANDA); *ibid*., 5 May 2002, *Anda collectors 72* (ANDA); *ibid*., 16 May 1993, *Anda collectors 112* (ANDA); *ibid*., 18 Dec 2004, 19 Dec 2004, *Anda collectors 112* (ANDA); *ibid*., 22 May 2007, *Hughes & Girmansyah MH1403* (E[3]); Mt. Tandikat, 23 Jul 1955, *Meijer 3812* (L); *ibid*., 1955, *Meijer 391* (BM); Muko muko, 54K N of Bukittinggi 5 Oct 1986, *Witnarti 24* (ANDA); Padang Pariaman, 30 Apr 2004, *Girmansyah 380* (BO); Road to Rimbo Panti, Sumatra: Road to Rimbo Panti 27 May 2007, *Hughes & Girmansyah MH140*7 (E); Talamau, s.d., *Bunnemeijer 372* (B, BO); Tambun Tulang, 29 October 1983, *Eliwiratma 09* (ANDA); *ibid*., 14 K S of Padang Pajang 10 Nov 1991, *Anda collectors 43* (ANDA); *ibid*., 14K S of Padang Pajang 10 Nov 1991, *Anda collectors 51* (ANDA); *ibid*., 14Km S of Padang Panjang 10 Nov 1991, *Anda collectors 52* (ANDA); Ulu Gadut, 28 Jul 2009, *Hughes MH1583* (BO). **Jambi**: G. Kerintji, 15 Mar 1920, *Bunnemeijer HAB. 8870* (BO).

5. ***Begonia harauensis*** Girm. (Hughes *et al.* 2015a: 14).

Type:—INDONESIA. Sumatra, West Sumatra: Lembah Harau Nature Reserve, 500 m, 24 vii 2009, *Hughes & Rubite MH1557* (holotype BO; isotype E [E00428068]). Fig. 2D.

Erect caulescent herb to ca. 50cm tall. **Stem** glabrous, red, internodes 2–8 cm long. **Stipules** deciduous, glabrous, lanceolate, 8 × 4 mm, tip acute. **Leaves**: petiole 1.5–4 cm, minutely puberlent; lamina basifixed, lanceolate, glabrous, strongly asymmetric, base shallowly cordate to sub truncate, tip long acuminate, 8–16 × 2–5.5 cm, uniform pale green, midrib 7–13 cm, venation palmate-pinnate, margin subentire to sparsely denticulate. **Inflorescences** terminal, up to 22 cm in total length, a raceme of cymes, glabrous, with 2–4 female flowers at the base, up to ca. 50 male flowers distally, protogynous; primary peduncle 3–7 cm; bracts deciduous, elliptic, glabrous, entire, ca. 7 × 5 mm, apex rounded. **Male flower**: pedicel ca. 5 mm, glabrous; tepals 4, pale pink, outer 2 tepals orbicular, ca. 7 × 6 mm, glabrous or minutely puberlent adaxially, inner 2 elliptic obovate, ca. 5 × 3 mm; androecium pale yellow, symmetric, globose, stamens ca. 35, filaments subequal, ca. 0.5 mm, arranged on a short column, anthers oblong, ca. 0.5 mm, apex retuse, hooded, dehiscing through slits about half the length of the anther, slits placed laterally. **Female flower**: pedicel 2–5 mm, glabrous; ovary glabrous, three winged, wings green, equal, 15 × 4 mm, capsule ellipsoid, 3-locular, placentae bifid; tepals 5, pale pink, outer 2 ovate, ca. 7 × 5 mm, inner 3 elliptic, smaller; styles 3, yellow, ca. 4 mm long, bifid, u-shaped, stigmatic band once spirally twisted. **Fruit** usually in pairs, total size 17 × 15 mm, on a stiff pedicel, recurved at maturity.

Distribution:—Endemic to the Lembah Harau Nature Reserve and nearby forests to the east of Payakumbuh in West Sumatra, at altitudes of 400–600(–800) metres. Fig 5.

Conservation assessment:—Least Concern. Although a narrow endemic, part of the distribution is in a protected area, and the large number of specimens in ANDA indicate this is a reasonably common forest floor species.

Additional specimens examined:—INDONESIA. Sumatra: **West Sumatra**: Kepala Banda, *ANDA collectors* 4 (ANDA); ibid., 22 Oct. 1989, *ANDA collectors 106* (ANDA); ibid., 22 Oct. 1989, *ANDA collectors 142* (ANDA); ibid., 3 Apr. 1988, *Darmansyah 33* (ANDA); ibid., 10 Apr. 1988, *Lani & Arnov 48* (ANDA); ibid., 10 Nov. 1984, *Meriyatmi, E. 12* (ANDA); ibid., 3 Apr. 1988, *Ranti* 12 (ANDA); ibid., 3 Apr. 1988, *Suluh 41* (ANDA); Lembah Harau Nature Reserve, 3 Apr. 1988, *Heravela 22* (ANDA); ibid., 27 Aug. 1983, *Hotta 335* (ANDA); ibid., 24 Jul. 2009, *Hughes & Rubite MH1557* (E); ibid., 23 Jul. 2009, *Hughes & Taufiq MH1556* (E); Lembah Harau Nature Reserve, Sarasah Bonta, 14 Nov. 1992, *ANDA collectors 9* (ANDA); ibid., 27 Aug. 1983, *ANDA collectors 4R* (ANDA); ibid., 2 Apr. 1988, *ANDA collectors 11* (ANDA); ibid., 2 Mar. 2001, *ANDA collectors* 29 (ANDA); ibid., 14 Nov. 1992, *ANDA collectors 49* (ANDA); ibid., Dec. 1994, *ANDA collectors 51* (ANDA); ibid., 15 Nov. 1992, *ANDA collectors 63* (ANDA); ibid., 10 Dec. 1994, *ANDA collectors 67* (ANDA); ibid., 11 Dec. 1994, *ANDA collectors 92* (ANDA); ibid., 11 Dec. 1994, *ANDA collectors 95* (ANDA); ibid., 11 Dec. 1994, *ANDA collectors 99* (ANDA); ibid., 10 Dec. 1984, *ANDA collectors 156* (ANDA); ibid., 11 Dec. 1994, *Fit, Nung, Eci, Tis & Martin 78* (ANDA); ibid., 10 Dec. 1994, *Irya, Eva, Del, Titin & Yenny 48* (ANDA); ibid., 27 Aug. 1983, *Nelly, Delli, Harry & Eka 83* (ANDA); ibid., 10 Dec. 1994, *On, Fera, Yat, Tin & Rina, S. 3* (ANDA); ibid., 11 Dec. 1994, *Pions, Eka, Wasti, Dewi & Len 68* (ANDA); West Sumatra, Pajakumbuh, Taram, 3 Apr. 1988, *Johanes, R. 23* (ANDA); ibid., 23 Aug. 1956, *Meijer, W. 6843* (L); River Tjampo, Aug. 1957, *Ismail 47* (L).

6. *Begonia holttumii* Irmscher (1929: 113).

Type:—MALAYSIA. Penang: Batu Etam, ix 1894, *Curtis 1262* (lectotype SING; isolectotype KEP, designated by Kiew (2005)).

Erect caulescent herb to 1 m tall. **Stem** with scattered minute hairs, glabrescent, internodes 3–12 cm long. **Stipules** deciduous, glabrous, lanceolate, 15–20 × 3–12 mm, keeled, entire, tip acuminate. **Leaves**: petiole 3–12 cm long, glabrous; lamina basifixed, ovate, 14–35 × 7–13 cm, asymmetric, base cordate, upper surface sparsely puberlent, uniform green, lower surface puberlent, more so on the veins; margin dentate-denticulate, glabrous, apex acuminate. **Inflorescences** terminal or axillary, total length 5–18 cm, raceme with up to 3 pairs of female flower basal and many male flowers distal, primary peduncle 2–5 cm, protogynous; bracts ovate, 2 × 6 mm. **Male flower**: pedicel 2.5–12 mm, glabrous; tepals 4, outer 2 elliptic, white, base truncate, ca. 7 × 5 mm, inner 2 ca. 5 × 2.5, entire; androecium yellow, symmetric, cluster conical, stamens many; filaments 1 mm, fused into a short column; anthers obovate, 2 mm long, slits unifacial, about 1.2 the length of the anther, hooded, tip retuse. **Female flower**: pedicel 7–10 mm; ovary sparsely puberlent, with three equal wings, oblong in outline, total size 20 × 12–15 mm, capsule 3-locular, ellipsoid, 15–19 × 7 mm; tepals 5, white, puberulent outside, margin entire, apex rounded, outermost obovate, 4–15 × 3–7 mm, styles 3, yellow, Y-shaped, surface twice spirally twisted. **Fruit** one to 3 pairs, recurved on a stiff 4–8 mm long pedicel, oblong-triangular, total size 15–25 × 12–20 mm.

Distribution:—A terrestrial species of lowland forests in northern Sumatra and Peninsular Malaysia, at altitudes of less than 400 metres. Fig. 3.

Conservation assessment:—Data Deficient. Most of the collections are early 20th century, with only one modern collection (Takeuchi & Sambas 18251). This may be due to the scarcity of the lowland forest habitat of this species, but further field surveys would be useful to understand the size of extant populations.

Notes:—Initially thought to be endemic to Peninsular Malaysia (Kiew 2005), and confirmed from Sumatra by Hughes (2008). Illustrated in Hughes *et al.*, (2018b).

Additional specimens examined:—INDONESIA. Sumatra. **Aceh:** Sikundur Forest Reserve: Besitang River, 7 August 1979, *de Wilde & de Wilde-Duyfies 19521* (BO, L). **North Sumatra:** Asahan, Hoeta Bagasan, 7 September 1934–4 February 1935, *Rahmat Si Boeea 6555* (A, MICH, S); Asahan, Si Manoeng, Asahan River waterfall, 20 February 1927–23 February 1927, *Bartlett 6727* (MICH, NY); Asahan, Silo Maradja, July 1928–August 1928, *Rahmat Si Boeea 857* (A, E); Sumatra East coast, *Yates* 1138 (BM); Sumatra East coast, 1914–1917, *Surbeck 453* (L); Sumatra East coast, *Yates* 1138, (B, P); Sumatra East coast, Simeloengoen, Ack na Gerger, 7 June 1927–8 June 1927, *Bartlett 8268* (MICH); Sumatra East coast: Simeloengoen, Ria Na Poso, 7 June 1927, *Bartlett 8301* (MICH); Tapanuli Selatan, Newmont Martabe Project site, 7 June 2003, *Takeuchi & Sambas 18251* (WAN); Tapanuli, Padang Lawas: Hoeta Imbaroe, 20 June 1933, *Rahmat Si Boeea 4626* (K, S).

7. *Begonia isoptera* (Dryander 1791: 160).

Type:—INDONESIA. Java, *Anon, s.n.* (holotype LINN [LINN-HS 1474.6]).

Stems up to 100 cm tall and 0.5–1 cm thick at the base, internodes 4–1 0 cm long. **Stipules** caducous. **Leaves**: petiole translucent, with or without hairs, grooved above, 1.5–2 cm long; lamina oblique, ovate-broadly oblong, strongly asymmetric, 10–15 × 5–6 cm, broad side 3–4 cm wide, basal lobe broadly rounded l.5–2 cm long, margin entire to sparsely serrulate at the vein endings without minute teeth in between, apex narrowly elongate; venation palmate-pinnate, 5 pairs of veins, 2 veins in basal lobe, veins plane above. **Inflorescences** terminal and axillary, shorter than the leaves, a couple of female flowers at base and many fine branches of male flowers above, protogynous. **Male flowers**: pedicel 5–10 mm long tepals 2, glabrous, white, broadly rounded ca.10 × 10 mm, margin not toothed, tip rounded; stamens ca. 40, cluster globose; filament 0.5–1 mm long; anthers obovate, tip notched, opening by slits, pale yellow, 0.7–1.1 mm long. **Female flowers**: pedicel 5–7 mm long; ovary oblong, glabrous, wings 3, slightly unequal, locules 3, placentas 2 per locule, 5–10 mm long; tepals 3, ovate, entire, tip pointed, ca. 10 × 15 mm; styles 3, U shape, ca. 7 mm long, stigma spiral. **Fruit** obconical; pedicel 2–3 cm long; capsule oblong, 2–3 × 2–2.5 cm; locules 3; wings 3, slightly unequal, obovoid with almost truncate at the apex, thinly fibrous, 5–8 mm wide.

Distribution:—The bulk of the distribution lies in western Java, with collections from Sumatra being restricted to Lampung in the far south on Gunung Tanggamus, Gunung Pakiwang and near Kota Agung, from 400–1200 m altitude. Fig. 3.

Conservation assessment:—Least Concern (LC). Widespread in western Java.

Notes:—Some of the specimens cited under this name in Hughes (2008) from Sumatra and the Lesser Sunda Islands belong to other species: *B. racemosa* (Sumatra), *B. brangbosangensis* and *B. jaranpusangensis* (Sumbawa) and *B. lombokensis* (Lombok) (Girmansyah 2008, 2016). On Java this species has some variation in indumentum, whilst on Sumatra it is entirely glabrous (Ayu *et al.* 2019). See also notes under *B. racemosa*.

Additional specimens examined:—INDONESIA. Sumatra. **Lampung**: Gunung Tanggamus, 4 Feb 2016, *Hughes et al. SUBOE 74* (BO(2), E); Gunung Tanggamus, 9 July 1928, *de Voogd 160* (BO, L); Gunung Tanggamus, 27 April 1968, *Jacobs 8096* (A, K, L); Gunung Tanggamus, 16 January 1998, *Hoover & des Cognets 846*, (BO[2]); NW of Kota Agung, 11 May 1968, *Jacobs, M., 8345* (BO[2], L). **South Sumatra**: Palembang, Gunung Pakiwang 7 February 1929, *de Voogd 450* (BO, L).

8. *Begonia kemiriensis* Girm. & M.Hughes **sp. nov.**

Type:—INDONESIA. Sumatra, Aceh: Gunung Kemiri, 2100 m, 11 iii 2008, *Wilkie et al. PW692* (holotype BO; isotype E [E00533070], SING). Fig. 6B.

Diagnosis. Most closely allied to *B. laruei*, differing in the larger size of the flowers (male flower outer tepals ca. 15 × 14 mm, not ca. 5 × 5 mm), with ovate-lanceolate leaves (not with 2–4 pointed lobes extending to around 1–5 cm).

Erect herb ca. 1 m tall. **Stem** little branched, glabrous, stout, internodes 3–10 cm long. **Stipules** lanceolate, 12 × 5 mm, entire, acuminate, hairy along the middle, persistent. **Leaves**: petiole 2.5–10.5 cm long, minutely puberlent at the apex; lamina basifixed, ovate-lanceolate, asymmetric, cordate at the base, 8–15 × 4–8 cm, midrib 6–12 cm, upper surface uniform green, sparsely puberlent, lower surface sparsely puberlent, venation palmate-pinnate, margin denticulate, apex acuminate. **Inflorescence** terminal, up to 25 cm long, bisexual, protogynous, cymose-racemose; bracts ovate, white, entire, glabrous, ca. 7 × 5 mm; female flower basal in pairs, male flowers distal, ca. 20–50 in number. **Male flowers**: pedicel 5–8 mm long, glabrous; tepals 4, white, outer 2 orbicular, entire, minutely sparsely puberlent on the reverse, ca. 15 × 14 mm; inner 2 obovate, 12 × 6 mm; androecium ovoid, stamens ca. 50, yellow, filaments 0.75 mm, fused at the base; anthers 1.5 mm long, elliptic-obovate, hooded, slits unifacial, ¾ the length of the anther, tip retuse. **Female flowers**: in pairs from a common peduncle ca. 2 cm long; pedicel 1.5–2 cm; ovary minutely puberlent, ca. 12 × 24 mm including wings, with 3 equal wings, 3-locular; capsule sub-globose, ca. 8 mm diameter, placentae bifid; tepals 5, white, obovate, ca. 17 × 10 mm, entire, minutely puberlent on the reverse, styles 3, Y-shaped, fused halfway, stigmatic surface once spirally twisted. **Fruit** borne in pairs on stiff 15–25 mm pedicels, not recurved, broadly rounded-triangular, ca. 15 × 25 mm including wings.

Distribution:—Endemic to Gunung Kemiri in Sumatra at ca. 2200 metres altitude. Fig. 4.

Conservation assessment:—Least Concern. Although a narrow endemic, Gunung Kemiri is part of the Leuser Ecosystem and forests at this altitude are not under immediate threat.

Notes:—The closest relative to this species, *B. laruei*, occurs up to 1700 metres altitude on Gunung Kemiri.

9. *Begonia laruei* Hughes *et al.* (2009: 33).

Type:—INDONESIA. Sumatra, North Sumatra: Gunung Sibayak, 12 v 2007, *Hughes & Girmansyah MH1389* (holotype E [E00261264]; isotype BO). Fig. 6C.

Plant erect, 50–100 cm high. **Stem** woody, especially at the base, glabrous, ca . 8 mm wide, internodes 4–10 cm apart. **Stipules** lanceolate, ca. 8 mm long, caducous. **Leaves** alternate; petiole 2.5–8 cm long, glabrous; lamina lanceolate, strongly asymmetric, with 2–4 pointed lobes extending to around 1–5 cm, basifixed, cordate at base, lobes not overlapping, 11–25 × 3.5–10 cm, midrib 9–15 cm long, venation palmate; upper surface dark green with silver markings between the veins or uniform green, glabrous; underside pale green, glabrous; margin glabrous, with small teeth between the lobes, apex acuminate. **Inflorescence** protogynous, bisexual, terminal, cymose, branching up to 6 times; bracts 4 × 5 mm, entire or slightly retuse, deciduous. **Male flowers** : pedicel 4 mm, glabrous, tepals 4, glabrous; outer tepals reddish or dirty pink, more so towards the base, sometimes white, orbicular, truncate at base, ca 5 × 5 mm, margin entire; inner tepals ca 4 × 2 mm, paler than the outer; androecium symmetric, yellow; stamens ca 30; filaments short, on a column; anthers hooded, ca . 1 mm long, lower ones sub-sessile, upper ones on a short filament. **Female flowers** : pedicel ca 4 mm long; ovary 3 locular, with three equal wings, placentae bifid; tepals 5, obovate, ca 8 × 4 mm, margin entire; stigma with three styles, deciduous. **Fruit** truncate to slightly retuse at base, pale brown, dehiscent, pendulous, usually borne in pairs; wings equal, bases not extending along the pedicel, rounded at the tips, 14 × 6 mm; capsule shape broadly oval, 12 × 9 mm..

Distribution:—Endemic to North Sumatra and Aceh at altitudes of 400–1700 m. Terrestrial forest floor herb found in lower and mid-montane forest. Fig. 5.

Conservation assessment:—Least Concern. Commonly collected and encountered in Aceh and North Sumatra.

Notes:—We have used quite a broad species concept here, especially in comparison with recent work on sect. *Petermannia* in Sabah and Sarawak (e.g. Chong *et al.* 2015; Sang *et al.* 2015). It may be that further field and DNA studies will permit the splitting of this variable species into a number of narrow endemics.

Additional specimens examined:—INDONESIA: Sumatra: **Aceh**: Gunung Ketambe, 16 May 1972, *de Wilde & de Wilde-Duyfjes 12006* (BO, L [2]); *ibid.*, 19 Jul 1972, *de Wilde & de Wilde-Duyfjes 13814* (BO, L); Gunung Leuser Nature Reserve, Gunung Mamas, 7 Feb 1975, *de Wilde & de Wilde-Duyfjes 14632* (L); Gunung Leuser Nature Reserve, Ketambe Research Station, 28 Jul 1979, *de Wilde & de Wilde-Duyfjes 19206* (BO); Lau Alas, 6 Jun 1972, *de Wilde & de Wilde-Duyfjes 12627* (BO, L); Mamas River, 27 Jun 1979, *de Wilde & de Wilde-Duyfjes 19164* (BO [2], L); Blang Kedjeren, 15 Feb 1937, *van Steenis 337* (BO); Bur ui Papandji, 23 Jun 1930, *Frey-Wyssling 45* (BO); Gajolanden, 21 Mar 1937, *van Steenis 9914* (BO, L); Gunung Leuser National Park: Gunung Kemiri, on path from camp 1 to camp 2, 11 Mar 2008, *Wilkie et al. PW665* (BO); Gunung Leuser National Park: Ketambe Research Station, 7 Mar 2008, *Wilkie et al. PW624* (BO); Gunung Leuser National Park: Ketambe Research Station, 6 Mar 2008, *Wilkie et al. PW612* (BO); Gunung Leuser National Park: Ketambe Research Station, 7 Mar 2008, *Wilkie et al. PW613* (BO); Gajolanden, G. Goh Lemboeh, 18 Feb 1937, *van Steenis 8882* (BO); Kutacane, Gumpang, 7 Mar 1982, *Sulistiarini 44* (BO); Gunung Leuser National Park: Gunung Kemiri, 11 Mar 2008, *Wilkie et al. PW680* (BO). **North Sumatra**. Brastagi, 3–17 Apr 1925, *Yates 1400* (BO); Dolok Singgalang, 25 May 1922, *Lorzing 8863* (BO); Gunung Sibayak, 7 Dec 1988, *Kessler 105* (B, L[2]); *ibid.*, 5 May 1928, *Lorzing 14038* (BO); Gunung Sinabung, 14 May 2007, *Hughes & Girmansyah MH1398* (BO[2], E); Lae Banalsal, 17 Nov 1941, *Surbeck 554* (L); Sarinembah, 28 Jun 1918, *Bartlett & La Rue 200* (A, L); Karoland, Petjeren, 22 Jun 1928, *Hamel & Rahmat Si Toroes 782* (A); Bandar Baru, Sungai Tepi, 20 May 1981, *Meijer 15803* (BO, L); Bandar Baru, 3 Feb 1917, *Lorzing 4689* (BO).

10. *Begonia multijugata* Hughes *et al.* (2009: 36).

Type:—INDONESIA. Sumatra, Aceh: Gunung Leuser Nature Reserve, Air Panas, 433 m, 18 iii 2008, *Wilkie et al. PW768* (holotype BO; isotype E [E00502329], SING). Fig. 6.

Erect glabrous herb to 50 cm high. **Stem** slightly woody when dry, glabrous, internodes 5–20 cm long, red. **Stipules** lanceolate, ca. 20 × 6 mm, with minute glandular hairs on the reverse, with a very small extension at the tip, deciduous. **Leaves**: petiole 1.5–6 cm long, glabrous; lamina ovate-lanceolate, asymmetric, basifixed, cordate at base, lobes not overlapping, 12–22 × 5–9 cm, midrib 10–17 cm long, venation palmate-pinnate; upper surface dark green with white spots between the veins, glabrous, underside wine-red, glabrous; margin glabrous, toothed at the end of the veins with smaller teeth between, apex acuminate. **Inflorescence** axillary, very compressed, protogynous, bisexual; bracts translucent white. **Male flowers**: pedicel length 10 mm, glabrous; tepals 2, white, glabrous, 6 mm long, obovate, margin entire; androecium pale yellow, symmetric, almost conical; stamens 30, filaments shorter than the anther at the base,

becoming slightly longer toward the apex, anther 0.75 mm long, obovate, hooded, dehiscing through short slits less than half the length of the anther, connective retuse. **Female flowers**: pedicel up to about 1 cm long; ovary 3 locular, with three equal wings, wings rounded-triangular, 2–3 mm wide, placentae bifid; tepals 5, white, obovate-orbicular, 6 mm long, margin entire; stigma yellow, with three styles, once spirally twisted, deciduous. **Fruit** pale brown, borne in a cluster of up to 5 pairs, each pair ca 5 mm apart; wings narrow, capsule broadly elliptic, 7–9 × 6–7 mm.

Distribution:—Endemic to Aceh, in Gayo Lues, Aceh Tenggara, Aceh Seletan, at altitudes of less than 400 metres. Fig. 4.

Conservation assessment:—Least Concern. The bulk of the distribution is in the Leuser Ecosystem.

Additional specimens examined:—INDONESIA: Sumatra: **Aceh**. Gajolanden, 25 Feb1937, *van Steenis 9291* (BO, L); Lau Alas, 2 Jun 1972, *de Wilde & de Wilde-Duyfjes 12537* (L[2]); Kloet Nature Reserve, 10 Jul 1985, *de Wilde & de Wilde-Duyfjes 19910* (BO, L).

11. *Begonia padangensis* Irmscher (1953: 475).

Type:—INDONESIA. Sumatra, West Sumatra: Gunung Singalan, *Beccari PS125* [*4507F*] (lectotype FI, designated here; isolectotype FI[4], K, L; merotype B[4]). Fig. 7A.

Erect suffrutescent herb to 1 m high. **Stem** woody when dry, glabrous, internodes 2–11 cm long. **Stipules** lanceolate, 10 × 4 mm, glabrous, acuminate, ending in a 2 mm filiform tip, deciduous. **Leaves**: petiole 8–30 mm, minutely tuberculose, tomentose; lamina ovate-elliptic, asymmetric, basifixed, cordate at base, lobed not overlapping, 6.5–17 × 2.5–7 cm, midrib 5.5–14 cm, venation pinnate-palmate; upper surface dark green, sparsely minutely puberlent, under surface sparsely minutely puberlent with slightly longer, denser, hairs on the veins; margin dentate-denticulate, with sparse minute hairs; apex acuminate. **Inflorescence** terminal, total length 6–9 cm, primary peduncle 1–2 cm, protogynous, bisexual or unisexual, consisting of a simple cyme with 2 female flowers and 1 central male flower, or a twice-branched cyme with 5–8 male flowers; bracts caducous, filiform, 5 × 2 mm. **Male flowers**: pedicel length 1.5–2 cm, sparsely puberlent; tepals 2, with 2 minute inner tepals sometimes present, white, glabrescent, broadly ovate-orbicular, 12–15 × 14 mm, entire; androecium symmetric, globose, yellow, with ca. 35 stamens; filaments equal, ca. 0.5 mm long, fused into a short column at the base; anthers 2 mm long, elliptic-oblong, hooded, slits unifacial, 1/3 the length of the anther, tip minutely retuse. **Female flowers**: pedicel length 10–15 mm, sparsely puberlent; ovary 3-locular, pale pink to whitish, with 3 sub equal rounded-triangular wings, total size 20 × 16 mm, with scattered hairs near the apex, apex truncate, capsule ellipsoid, 12 × 3 mm; tepals 5, ca. 12 × 9 mm, subequal, white, glabrous, entire; styles 3, Y-shaped, fused for about half the length, stigmatic surface once spirally twisted. **Fruit** pale brown, borne in pairs, pendulous on a thin ca. 25 mm pedicel, total size 25–28 × 24–25 mm.

Distribution:—Endemic to montane forests in West Sumatra, on Gunung Merapi, Gunung Sago, Gunung Singgalang and Gunung Talamau at altitudes of (600–)1400–1800 m. Fig. 5.

Conservation assessment:—Least Concern. The higher altitude forests which this species inhabits are some of the best protected in West Sumatra.

Notes:—The few flowered inflorescences with large flowers are distinctive, as are the tuberculose short petioles.

Additional specimens examined:—INDONESIA. Sumatra: **West Sumatra**: Gunong Merapi, 26 Jul 2009, *Hughes & Taufiq MH1571* (BO, E); Mt. Singgalang, 13 Feb 1998, *Hoover & Hunter 870* (BO); Mt. Merapi, 15 Feb 1998, *Hoover & Hunter 873* (BO[2]); Mt. Merapi, 18 Feb 1998, *Hoover & Hunter 875* (BO); Mt. Singgalang, 6 Jun 2004, *Girmansyah DEDEN393* (BO[4]); Mt. Merapi, 10 Jun 2004, *Girmansyah DEDEN398* (BO[3]); G. Merapi, 18 Sep 1918, *Bunnemeijer 4684* (BO); G. Sago, 26 Jul 1918, *Bunnemeijer 3986* (BO); G. Merapi, 21 Jun 1953, *Borssum 2139* (BO); G. Singgalang, 27 May 1918, *Bunnemeijer 2611* (BO); G. Merapi, 13 Sep 1918, *Bunnemeijer 4502* (BO[3]); G. Singgalang, 21 Feb 2004, *Girmansyah et al. 8* (BO).

12. *Begonia racemosa* Jack (1822: 14). *Diploclinium racemosum* (Jack) Miquel (1856: 691).

Type:—INDONESIA. Sumatra, Bengkulu: Bukit Menyan, 1110 m, 19 viii 2010, *Girmansyah & Hughes DEDEN1509* (neotype BO; isoneotype E [E00416890]; designated by Hughes & Girmansyah, 2011b). Fig. 7.

Erect herb to 1 m high. **Stem** woody when dry, glabrous, internodes 5–8 cm long. **Stipules** lanceolate, ca 15 × 5 mm, glabrous, acuminate, ending in a 2 mm filiform tip, deciduous. **Leaves**: petiole 1–2.5 cm, sparsely puberlent; lamina oblong-elliptic, asymmetric, basifixed, cordate at base, lobed not overlapping, 11–16 × 5–7 cm , midrib 10–14 cm, venation pinnate-palmate; upper surface dark green, glabrous, under surface pale green, glabrous; margin dentate-

denticulate, with sparse minute hairs; apex acuminate. **Inflorescence** 10–15 cm long, male only or bisexual with 2 female flowers basal and 30–80 male flowers, protogynous; an elongate cyme with straight central axis, appearing racemose. **Male flowers**: pedicel length 5 mm , glabrous; tepals 2, reddish, glabrous, broadly ovate-orbicular, ca. 5 × 5 mm, entire; androecium symmetric, globose, yellow, with ca. 30 stamens; filaments equal, ca. 2 mm long, fused into a short column at the base; anthers ca. 1 mm long, elliptic-oblong, hooded, slits unifacial, 1/3 the length of the anther, tip minutely retuse. **Female flowers**: pedicel length ca. 5 mm, glabrous; ovary 3-locular, green, with 3 sub equal rounded-triangular wings, 15×10 mm, glabrous, apex rounded; tepals 3, ovate, ca. 12 × 9 mm, subequal, reddish at the base white, glabrous, entire; styles 3, Y-shaped, fused for about half the length, stigmatic surface once spirally twisted. **Fruit** pale brown, borne singly or in pairs, hanging vertically on a stiff ca. 7 mm pedicel, total size total size 25 × 14 mm, capsule ellipsoid, 22 × 5 mm.

Distribution:—Endemic to Sumatra in Bengkulu and South Sumatra at altitudes from 100–1200 metres. Fig. 3.

Conservation assessment:—Least Concern (LC). *B. racemosa* is known from Bukit Kaba, Bukit Hitam (protected areas) and Bukit Menyan. The latter location is not under protection and the already small forest fragment is under active encroachment from coffee plantations. However the species was found growing in slightly disturbed habitat by a trackside, indicating tolerance of a certain degree of disturbance. As long as Bukit Kaba and Bukit Hitam remain in good condition, we consider an assessment of Least Concern appropriate.

Notes:—*B. racemosa* is similar to and potentially easily confused with *B. isoptera*. Both are glabrous cane species with three tepals in the female flowers, however the ovary shape differs, being more triangular in *B. isoptera* and more rounded in *B. racemosa* (although there are some intermediate specimens, e.g., *Afriastini 2625*), and the leaves are more dentate in *B. isoptera*. In living material, the veins on the upper leaf surface differ, being raised in *B. isoptera*, and sunken in *B. racemosa* (Figs. 6A & 7B).

Additional specimens examined:— INDONESIA. Sumatra: **Bengkulu**: Kaba, 18 Mar 1932, *de Voogd 1325* (BO); Kaba, 1 Mar 1931, *de Voogd 1053* (BO[2]); Road from Kapahiang, 17 Aug 2010, *Girmansyah & Hughes Deden1498* (BO); S. Gembung, 12 Oct 1993, *Afriastini 2620* (BO); S. Gembung, 12 Oct 1993, *Afriastini 2625* (BO). **South Sumatra**: Palembang, Tanjung Agung, 10 March 1972 *Dransfield & Saerudin 2423* (K, L).

13. *Begonia repanda* Blume (1827: 97). *Diploclinium repandum* (Blume) Klotzsch (1854: 192).
Type:—INDONESIA. Java: *Blume s.n.* (lectotype L [L0532497] designated by Girmansyah (2005)). Fig. 7C.

Caulescent herb to 1 m tall. **Stems** often horizontal or pendant, internodes 2–10 cm long. **Stipules** persistent, lanceolate, margin entire, apex setose, 1–1.5 × 0.5 cm. **Leaves**: petiole terete, 2–5 cm long; lamina asymmetric, narrowly ovate-oblong, base usually acute on one side or sometimes slightly rounded, margin distinctly biserrate, apex acuminate, 12–15 × 4–6 cm, basal lobe rounded, 2–2.5 cm; venation palmate-pinnate, 7 pairs of veins, 2 veins in basal lobe. **Inflorescences** axillary, cymose panicle in the uppermost leaf axils on the main stem and branches, with up to ca. 25 male flowers and two female flowers, protogynous. **Male flowers**: pedicel 5–10 mm long; tepals 2, white, rounded, ca. 13 × 13 mm; stamens ca. 50, cluster globose; filaments ca. 0.5 mm long; anthers obovate, ca. 0.4 mm long, opening by slits. **Female flowers**: pedicel slender, 2–3.5 cm long; ovary ellipsoid, locules 3, placenta 2 per locule; wings 3, equal; tepals 5, margin serrulate towards the tip, 10–17 × 5–15 mm; styles 3, Y-shaped; stigma, spirally twisted. **Fruits** broadly ovoid; pedicel 2–2.5 cm long; capsule, ellipsoid, 2–2.5 cm long; wings 3, equal, broadly ellipsoid, papery when dry, dehiscing between wings and locules, 4–5 mm wide.

Distribution:—A montane forest species, found between (1500–)1600–2000(–2200) m altitude on Gunung Dempo, Gunung Talang and Gunung Tujuh on Sumatra, and several mountains in western Java including Gunung Gede and Gunung Pangrango. Fig. 3.

Conservation assessment:— Least Concern (LC). The range of this species in the montane forests of West Sumatra covers several protected areas.

Notes:—The rounded fruits are instantly distinctive, and when sterile there is a slight lateral curve to the midrib which is diagnostic. This species is allied to the Bornean *B. chaiana* (Kiew & Sang 2007; Kiew *et al.* 2015), endemic to the Kuching limestone in Sarawak. *Begonia repanda* was previously considered a synonym of *B. isoptera* (Hughes 2008), but confirmed as distinct by Girmansyah (2005).

Additional specimens examined:—INDONESIA. Sumatra: **West Sumatra:** G. Talang, *Hughes & Girmansyah MH1429* (BO, E); G. Talang, 25 Oct 1918, *Bunnemeijer 5089* (BO[2]); G. Talang, Laras Talang, 29 Oct 1918, *Bunnemeijer 5312* (BO[2]). **South Sumatra:** G. Dempo, Palembang, 20 May 1929, *de Voogd 381* (BO); Mt. Dempo, 21 Jan 1998, *Hoover & des Cognet 850* (BO[4]); Jambi: Mt. Tujuh, Village Kayu Aro, Distr. Sungai Penuh, 6 Jun 2004, *Girmansyah DEDEN387* (BO[2]).

14. *Begonia vuijckii* Koorders (1912: 647).

Type:—INDONESIA. Java: Gunung Salak, *Blume 6088* (lectotype B [B100238776], designated here).

Begonia tenericaulis Ridley (1925: 83) ***syn. nov.*** Type:—INDONESIA. Sumatra, Bengkulu: Lubuk Tandai, vi 1922, *Brooks 7608* (lectotype K [K000761218] designated here). Fig. 7D.

Caulescent herb to ca. 50 cm tall. **Stem** little branched, glabrous, internodes 3–9 cm long, glabrous. **Stipules** deciduous, lanceolate, margin entire, apex acute, 12 × 4 mm. **Leaves**: petioles slightly flattened above, 3–6 cm long; lamina ovate, asymmetric, cordate at the base, 7–15 × 5–8 cm, midrib 6.5–11.5 cm, upper surface uniform green, with rows of bristles evenly spaced between the veins above, glabrous below, venation pinnate-palmate, margin denticulate, apex acuminate. **Inflorescence** terminal, 7–12 cm long, bisexual, protogynous, cymose, with 2–4 female flowers at the base and 10–15 male flowers at the apex. **Male flowers**: pedicel ca. 8 mm long, glabrous; tepals 4, outer 2 coral pink, orbicular, entire, glabrous, ca. 6 × 6 mm; inner 2 elliptic, paler than the outer, 5 × 2 mm; androecium globose, stamens ca. 50, yellow, filaments ca. 1 mm long, anthers ca, 1 mm long, elongate-obtriangular, apex retuse. **Female flowers**: pedicel glabrous, 0,5–1 cm long; ovary 3-locular, pale green with pinkish wings, with 3 linear wings rounded at the base and apex, total size 1.5–2.5 cm capsule elongate-ellipsoid, 0.5–0.7 × 0.8–0.9 cm ; tepals 5, 0.2–0.3 × 0.8–0.9 cm, subequal, coral pink, paler at the margin, glabrous, entire; styles 3, Y-shaped, fused for about half the length, stigmatic surface once spirally twisted. **Fruit** pale brown, often borne in pairs, on a recurved ca. 10–20 mm pedicel, total size 3–3.5 × 1–1.5 cm

Distribution:—Java and Sumatra. Fig. 4.

Conservation assessment:—Least Concern (LC). Quite commonly collected, with some tolerance of disturbed habitats as it can be found beside trails.

Notes:—The bristles on the upper surface of the ovate leaves make this species distinct even when sterile. When flowering, the coral pink flowers are instantly distinctive. Although according to ITS data this species is closely related to members of sect. *Bracteibegonia*, the erect cane habit and protogynous terminal inflorescence with basal female flowers point to a placement in sect. *Petermannia*.

Additional specimens examined:—INDONESIA. Sumatra: **West Sumatra:** G. Gadut: Batu Gambir about 20 km east from Padang City, 15 Dec 1987, *Okada 4634* (BO); G. Gadut: Batu Gambir about 20 km east from Padang City, 15 Dec 1987, *Okada 4629* (BO); G. Gadut: From G. Gadut to Pinag-Pinang, 2 Jan 1988, *Hotta et al 165* (BO); Bukit Bedeng Sari, Paninggahan, 10 Jun 2010, *Girmansyah DEDEN1515* (BO[3]); Mt. Pantai cermin, 27 Jan 1998, *Hoover & des Cognets* 855 (BO); Ulu Gadut, 28 Jul 2009, *Hughes MH1582* (BO[4]); Riau: Bukit Tigapuluh, 31 Jul 2006, *Girmansyah, D. et al. Deden* 796 (BO[2]). **Lampung:** Kota Agung, 1915*, Cramer 60* (BO). **South Sumatra:** Bukit Sapulang Natural Reserve, 1–7 Feb 1983, *Afriastini JJ. 602*(BO); Sla Tiga, Palembang, 30 Jul 1932, *de Voogd 1454* (BO(4)); Rawas, Palembang, 15 Feb 1933, *de Voogd 1513* (BO). **Jambi:** Bangko to Marangin, 20 Jul 1025, *Posthumus 595* (BO). **Riau:** Mts Tigapulu 5 km W of Talanglakat, 6 Nov 1988, *Burley et al. 1205* (BO).

Species incompletely known

Begonia geniculata Jack (1822: 15). *Petermannia geniculata* (Jack) Klotzsch (1854: 124).

TYPE:—INDONESIA. Sumatra, *Jack s.n.* (destroyed).

Noted by Jack (1822) to have a 'considerable resemblance' to *B. racemosa*, *B. geniculata* lacks a type specimen and a well-defined locality and its identity remains a mystery (Hughes & Girmansyah 2011a).

***Begonia* sp. 5** [Sumatra: Bengkulu, *Girmansyah DEDEN1500* (BO); Bengkulu, *de Voogd 593* (BO[2], L)].

This species is sister to *B. racemosa* in the ITS phylogeny, which reflects geographic relationships rather than morphological ones. The leaves of this collection have very short petioles, and have bristles above on the leaf lamina, and prior to seeing the molecular data we were convinced this belonged in sect. *Bracteibegonia*. The female flowers remain unknown. Further collections are needed to accurately describe and sectionally place this taxon.

***Begonia* sp. A** [Sumatra: Bukit Lawang, *Soedarsono 289* (BO, K, L); Bukit Lawang, Maskuri 559 (BO[2], L) & 616 (BO, K, L).

This species is allied to *B. laruei*, but the leaves are not lobed, and the fruits are not as broad. We would like to see living material and ideally carry out some molecular work before deciding if this is distinct at the species level.

Discussion

Fourteen species of *Begonia* sect. *Petermannia* and allies are recorded from Sumatra, with several other taxa in the group incompletely known and requiring further field and laboratory work, particularly in North Sumatra and Aceh. West Sumatra is the most species rich, with eight species.

The molecular phylogeny provided here does little to help with the separation of *Begonia* sects. *Bracteibegonia* and *Petermannia*. *Begonia* sect. *Bracteibegonia* is certainly highly nested within a much more diverse *Petermannia* clade, however further sampling of Sumatran and especially Bornean species is needed, especially for chloroplast DNA sequences.

We regard this revision as being far from the final word on sect. *Petermannia* on Sumatra, but rather as a baseline for future work.

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Appendix 1.

B. aberrans MG993367*; *B. agusanensis* KF636453; *B. amphioxus* AF485150; *B. atricha* HQ729047; *B. berhamanii* KF636426; *B. biflora* JF975965; *B. bipinnatifida* KF636427; *B. bolsteri* KF636428; *B. bonthainensis* MG993354*; *B. aff. bracteata* MG993353*; *B. bracteata* MG993355*; *B. brevipes* HQ729048; *B. brevirimosa* AF485145; *B. burbidgei* MG993356*; *B. capituliformis* MG993357*; *B. cf. anthonyi* KF636431; *B. chiasmogyna* HQ729050; *B. chlorosticta* AF485153; *B. contracta* KF636433; *B. crispipila* HQ729051; *B. divaricata* MG993358*; *B. erythrogyna* KF636438; *B. fuscisetosa* KF636440; *B. gracilicyma* MG993359*; *B. hainanensis* KF636443; *B. hairauensis* MG993360*; *B. huangii* JF976004; *B. inostegia* KF636446; *B. isoptera* MG993379*; *B. isoptera* 1 AF485149; *B. isoptera* 2 KF636447; *B. kinabaluensis* KF636450; *B. koordersii* HQ729052; *B. lambii* KF636454; *B. laruei* HQ729058; *B. lepida* MG993361*; *B. macintyreana* HQ729054; *B. madaiensis* KF636462; *B. malachosticta* AF485156; *B. merrittii* KF636464; *B. morsei* AF485130; *B. negroensis* HQ729055; *B. ozotothrix* MG993362*; *B. padangensis* MG993363*; *B. palawanensis* MG993364*; *B. paracauliflora* KF636470; *B. pseudolateralis* HQ729053; *B. racemosa* MG993365*; *B. ramosii* HQ729057; *B. ramosii* KF636478; *B. repanda* MG993366*; *B. serratipetala* KF636484; *B. siccacaudata* MG993368*; *B. symsanguinea* AF485151; *B. varipeltata* HQ729056; *B. verecunda* MG993376*; *B. vuijckii* MG993377*; *B. wrayi* MG993378*; B. sp 1 MG993369*; B. sp 2 MG993373*; B. sp 3 MG993374*; B. sp 4 MG993375*; B. sp 5 MG993372*; B. sp 6 MG993371*; B. sp 7 MG993370*