

# The Gardens' Bulletin Singapore

VOL. 68(2) 2016

ISSN 0374-7859

The Gardens' Bulletin Singapore

Vol. 68(2) 2016



Singapore  
Botanic Gardens

Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569 Tel: 64719921 Telefax: 64674832

Singapore Botanic Gardens

# THE GARDENS' BULLETIN, SINGAPORE

The *Gardens' Bulletin, Singapore* is a peer-reviewed journal publishing *original papers* and *reviews* on a wide range of subjects: plant taxonomy (including revisions), phytogeography, floristics, morphology, anatomy, as well as horticulture and related fields, such as ecology and conservation, with emphasis on the plant life of the Southeast Asian-Pacific region.

Dr David J. Middleton      Dr Jana Leong-Škorničková  
(Editor-in-Chief)          (Managing Editor)

Felicia Tay                  Yee Wen Low                  Christina Soh  
(Graphics Editor)          (Copy Editor)                  (Business Manager)

## Editorial Advisory Board

Professor Sir Peter Crane <i>Yale University</i> <i>U.S.A.</i>	Dr Nigel P. Taylor <i>Singapore Botanic Gardens</i> <i>National Parks Board, Singapore</i>
Dr Rogier P.J. de Kok <i>Honorary Research Associate</i> <i>Singapore Botanic Gardens</i>	Dr Ian M. Turner <i>Royal Botanic Gardens Kew</i> <i>U.K.</i>
Dr W. John Kress <i>National Museum of Natural History</i> <i>Smithsonian Institution</i> <i>U.S.A.</i>	Dr Jan-Frits Veldkamp <i>National Biodiversity Center</i> <i>The Netherlands</i>
Dr Mark Hughes <i>Royal Botanic Garden Edinburgh</i> <i>U.K.</i>	Dr Jun Wen <i>National Museum of Natural History</i> <i>Smithsonian Institution</i> <i>U.S.A.</i>
Dr Kiat W. Tan <i>Gardens By The Bay</i> <i>Singapore</i>	Professor Nianhe Xia <i>South China Institute of Botany</i> <i>P.R. China</i>

Published twice yearly by the National Parks Board, Singapore, the annual subscription for the journal is Singapore \$100.00 including postage. Overseas subscribers should make payment in the form of bank draft or international money order in Singapore currency, payable to *National Parks Board*. Please forward payment to “**Accounts Receivable Section, National Parks Board, Headquarters, Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569**”.

## Instructions for contributing authors

(more details in <http://www.sbg.org.sg/research/instructions-for-authors.pdf>)

Manuscripts should be sent by e-mail to <Gardens\_Bulletin@nparks.gov.sg> or posted to The Editor, Gardens' Bulletin Singapore, Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569.

The language used is English. Prior to submission, it may be advisable to have manuscripts checked by someone fluent or proficient in that language. Contributions must not have been published or be under consideration elsewhere. There are no page charges. Submitted material cannot be returned.

Authors will receive a pdf reproduction of their contribution, *gratis*.

**Cover letter, submission and copyright.** In your **cover letter** or message, state clearly you are submitting your manuscript (state title) for publication in the Gardens' Bulletin, Singapore. By submitting the manuscript(s), authors agree that upon acceptance, **copyright** of the entire work becomes the property of the Singapore Botanic Gardens, National Parks Board, Singapore. Authors must ensure all required permission has been obtained in writing to publish any material they present; proof may be required. Manuscripts are best submitted in **electronic form** (Microsoft Word 97-2003 preferred). Use Times New Roman, 10-point font, 1.5-line spacing. Do not send original artwork unless requested by the Editor. Number all pages serially including the title and abstract on the first.

(continued on inside back cover)

## Instructions for contributing authors (continued)

**Title and authorship.** The title should concisely describe the contents. If a scientific name is used, its authority is normally excluded, but the family name would be provided. Authors' names, affiliations and postal/ e-mail addresses are stated below the title. If more than one author, indicate “corresponding author”. Avoid footnotes. A short **running title** (up to six words) should also be provided.

**Abstract.** The abstract should be less than 200 words. It should concisely indicate the article's contents without summarising it; mentioning novelties and name changes. **Keywords.** Suggest at most eight keywords, in alphabetical order.

**Scientific names and author abbreviations.** Genus and species names of organisms must be italicised and followed by the authority (with family name in parentheses) when first mentioned in the text or diagnoses. Standards for author abbreviations should follow:

IPNI <<http://www.ipni.org/ipni/authorsearchpage.do>>

Authors of Fungal Names <<http://www.indexfungorum.org/authorsoffungalnames.htm>>

**Herbarium abbreviations** follow

Thiers, B. (2013). [continuously updated] *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. <<http://sweetgum.nybg.org/ih/>>

**Journal and book title abbreviations.** For journals:

Bridson, G.D.R., Townsend, S.T., Polen, E.A. & Smith, E.R. (eds) (2004). *BPH-2: periodicals with botanical content: comprising a second edition of Botanico-Periodicum-Hunlianum*. Pittsburg: Hunt Institute for Botanical Documentation.

For books:

Stafleu, F.A. & Cowan, R.S. (eds) (1976–88). *Taxonomic Literature*. 2nd edition. 7 vols [Regnum Veg. vols 94, 98, 105, 110, 112, 115, 116].

Stafleu, F.A. & Mennega, E.A. (eds) (1992–). *Taxonomic Literature*. Supplements [Regnum Veg. vols 125, 130, 132].

A useful source of verifying names of publications is

<[http://asaweb.huh.harvard.edu:8080/databases/publication\\_index.html](http://asaweb.huh.harvard.edu:8080/databases/publication_index.html)>. If in doubt, list full titles.

**Other abbreviations and units of measurement.** If using standard abbreviations and acronyms, give the full term on first mention. Dates are cited as: 1 Jan 2000. SI (metric) units of measurement are used and spelled out except when preceded by a numeral; they are abbreviated in standard form: g, ml, km, etc. Coordinates should be given in the form 11°46'44.8"N 109°10'44.5"E.

**Tables.** Tables are numbered in arabic numerals in the order they are first mentioned in the text and carry an indicative legend at the head. Tables are given at the end of the manuscript.

**Illustrations.** All drawings, maps, graphs and photographic images (individually or collected in a plate) are to be numbered in arabic numerals in the order they are first mentioned in the text, as Fig. 1, Fig. 2, etc. (plate components would be referred to in the text as Fig. 1A, 1B, Fig. 1A–D, etc.). If relevant, scale bars should be used to indicate magnification.

When grouping photographs, the maximum page area 19.5 × 13 cm must be heeded. High resolution digital images may be submitted as *separate* files (line drawings in black and white at 600 dpi, photographs at 300 dpi) sent electronically or in a CD. Captions on figures should be added as a layer so that they can be further edited or send both captioned and uncaptioned versions. Do not embed images into the main text file and provide the legends for all figures at the end of the manuscript.

**References in the text.** Citation in the text should take the form: King & Gamble (1886) or (King & Gamble, 1886), or King et al. (1886) if more than two authors to a work. Use 2000a, 2000b, etc. if several papers by the same author(s) in one year are cited.

**References listed at the end.** There, works mentioned in the text are listed alphabetically as follows:

Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (1999). User's Guide to the DELTA Editor. <http://biodiversity.uno.edu/delta/> (accessed on 2 Aug. 2010).

Persson, C. (2000). Phylogeny of Gardeniaceae (Rubiaceae) based on chloroplast DNA sequences from the *rps* 16 intron and *trnL*(UAA)-F(GAA) intergenic spacer. *Nordic J. Bot.* 20: 257–269.

Ridley, H.N. (1930). *The Dispersal of Plants Throughout the World*. Ashford, U.K.: L. Reeve.

Smith, A.C. & Darwin, S.P. (1988). Rubiaceae. In: Smith, A.C. (ed) *Flora Viliensis Nova, A New Flora of Fiji* 4: 143–193.

References to web-based resources should include either a doi (digital object identifier) specification or full URL mentioning also the date it was accessed. Use of DNA sequences from GenBank should be acknowledged and the studies for which the sequences were generated should be cited.

**Style of nomenclatural summaries.** The following style is required:

*Ornithoboea arachnoidea* (Diels) Craib, Notes Roy. Bot. Gard. Edinburgh 11: 251 (1920); Burt, Notes Roy. Bot. Gard. Edinburgh 22: 294 (1958).

*Ornithoboea parishii* C.B. Clarke in A.D.C. & C.D.C., Monogr. Phan. 5(1): 148 (1883).

If authors include full bibliographic data for these works in the list of references at the end of the paper, they should also be mentioned in the text briefly, e.g., “Nomenclatural references researched include Blume (1849) and Roxburgh (1824).”

Homotypic synonyms should be provided in a block, stating the type at the end.

Front cover picture: *Begonia jambilahanuiana* (Photo by S. Julia)

# The Gardens' Bulletin Singapore

VOL. 68(2) 2016

ISSN 0374-7859

## CONTENTS

**M. Rodda, N. Simonsson Juhonewe & D.J. Middleton**

The taxonomic status of the presumed extinct Singaporean

*Hoya wallichii* (Apocynaceae: Asclepiadoideae) ..... 175

**R.P.J. de Kok, S. Sengun & G.L.C. Bramley**

Two new records for the Lamiaceae of Singapore ..... 189

**R.P.J. de Kok**

Notes on the monotypic genus *Hexapora* (Lauraceae),

endemic to Peninsular Malaysia ..... 201

**J. Leong-Škorničková & R. Kiew**

*Hanguana fraseriana* (Hanguanaceae),

a new species from Peninsular Malaysia ..... 209

**T.L. Yao**

Nomenclatural updates and new records

in Peninsular Malaysian Pentaphylacaceae ..... 215

**R. Kiew**

*Impatiens* (Balsaminaceae) species from karst limestone

in Kelantan, Malaysia, including three new species ..... 225

**R. Kiew, S. Julia & C.Y. Ling**

The Calcareo group of *Begonia* (Begoniaceae) from Borneo,

including four new species from Sarawak ..... 239

**S. Julia & R. Kiew**

Eight new *Begonia* (Begoniaceae) species from the Lanjak Entimau  
Wildlife Sanctuary and Batang Ai National Park, Sarawak, Borneo ..... 257

**N.K.E. Undaharta & W.H. Ardi**

Studies on *Begonia* (Begoniaceae) of the Moluccas III:  
A new *Begonia* from Seram, Indonesia ..... 279

**J. Leong-Škorničková, Q.B. Nguyễn, H.Đ. Trần & E. Závěská**

*Etilingera poulsenii* and *Hornstedtia bella* (Zingiberaceae: Alpinieae),  
two new species from central Vietnam ..... 287

**J.D. Mood, N. Tanaka, M.M. Aung & J. Murata**

The genus *Boesenbergia* (Zingiberaceae)  
in Myanmar with two new records ..... 299

**K. Karthigeyan, M. Das Das & L.S. Wijedasa**

*Memecylon cerasiforme* (Melastomataceae): a poorly known species  
rediscovered, redescribed and newly recorded for India ..... 319

**BOOK REVIEW**

Flora Malesiana, series I – Seed Plants. Volume 22: Lythraceae.  
W.J.J.O. de Wilde & B.E.E. Duyfjes. P.C. van Welzen (Ed.) 2016.  
(D.J. Middleton) ..... 327

Date of publication: 15 November 2016

---

Copyright ©  
National Parks Board  
Singapore Botanic Gardens  
1 Cluny Road  
Singapore 259569

Printed by Oxford Graphic Printers Pte Ltd

## The taxonomic status of the presumed extinct Singaporean *Hoya wallichii* (Apocynaceae: Asclepiadoideae)

M. Rodda<sup>1</sup>, N. Simonsson Juhonewe<sup>2</sup> & D.J. Middleton<sup>1</sup>

<sup>1</sup>Herbarium, Singapore Botanic Gardens, National Parks Board,  
1 Cluny Road, Singapore 259569  
rodda.michele@gmail.com

<sup>2</sup>National Research Institute of Papua New Guinea, P.O. Box 1 – 524,  
Ukarumpa, Eastern Highlands Province 444, Papua New Guinea

**ABSTRACT.** After critical study of type material and all available collections, the identity of *Hoya wallichii* (Wight) C.M.Burton as a species distinct from *Hoya campanulata* Blume is clarified. *Hoya wallichii* was previously considered to be endemic to Singapore but had become nationally extinct and consequently globally extinct. This study reveals, however, that it is also found in Peninsular Malaysia and Brunei and, even though it is still nationally extinct in Singapore, it is no longer globally extinct. *Hoya campanulata* is widespread and locally common in Sundaland but also nationally extinct in Singapore. The two species are fully described and illustrated by line drawings and colour photographs. Two conservation assessments are made, three names are lectotypified, and one name is epitypified. This paper exemplifies how critical taxonomic understanding is fundamental to meaningful conservation assessments.

**Keywords.** Borneo, Brunei, conservation, epitype, IUCN, lectotype, Malaysia

### Introduction

There are very few endemic plant species in Singapore as almost all species originally described from Singapore have later been found to also occur in Malaysia and/or Indonesia. Ridley (1900) listed 33 species endemic to Singapore. This number was greatly reduced by Kiew & Turner (2003) who listed only five taxa (plus two endemic hybrids). Of these five, *Spatholobus ridleyi* King has since been found in Malaysia (specimens in L) and the others are presumed extinct (Kiew & Turner, 2003; Chong et al., 2009). Due to discoveries made since the publication of Kiew & Turner (2003) there are now considered to be four extant species of plants endemic to Singapore (Tan et al., 2004; Leong-Škorničková et al., 2014; Leong-Škorničková & Boyce, 2015). *Hoya wallichii* (Wight) C.M.Burton, however, has been overlooked in the previous studies on Singaporean endemics, largely due to its unclear identity and subsequent confusion with *H. campanulata* Blume. Hooker (1885) noted that *Hoya* R.Br. is a 'most difficult genus to describe from dried specimens' because the complex morphology of the corolla and corona is obscured in dried specimens. This is a problem in many groups of plants but for some, including *Hoya*, closely related species that are readily

distinguished from fresh or pickled flowers can be extremely difficult to tell apart from herbarium collections alone. Problems of name application in *Hoya* are not rare. Recent interest in *Hoya* has focused on phylogeny (Wanntorp et al., 2006a, 2011, 2014) and generic circumscription (Wanntorp et al., 2006b), as well as on species-level taxonomy (e.g. Rodda, 2015 and references therein). Typification of *Hoya* names where necessary, followed by taxonomic revision based on both herbarium specimens and new collections from areas previously poorly collected, are urgently needed to ensure correct name usage in phylogenetic and biogeographic studies.

No collections have been reported from Singapore of plants identified as *Hoya wallichii* since 1894. If it is a species distinct from *Hoya campanulata* and is endemic to Singapore this leads to the presumption that it is nationally and globally extinct. In this paper we set out to investigate whether *Hoya wallichii* is distinct from *H. campanulata*, clarify whether *H. wallichii* is an endemic species in Singapore, and assess whether *H. wallichii* has become globally extinct.

### The taxonomic history of *Hoya wallichii*

*Hoya wallichii* was first published as *Physostelma wallichii* Wight (Wight, 1834). *Physostelma* Wight, initially a monotypic genus, was separated from *Hoya* on filament characters. It was also described as having a campanulate corolla, a character already known in *Hoya* at that time but for only a handful of species, including *Hoya campanulata* described by Blume (1826) from Java. As more *Hoya* species were subsequently described, a campanulate or semi-campanulate corolla was observed for many species ranging from Myanmar to Papua New Guinea (Rodda & Nyhuus, 2009). Despite this, and the lack of any real distinction from *Hoya* in the filament characters, *Physostelma wallichii* was transferred to *Hoya* only relatively recently (Burton, 1996).

Recognition of the similarity between *Hoya wallichii* and *Hoya campanulata* began when Decaisne (1844) moved *Hoya campanulata* into *Physostelma* as *P. campanulatum* (Blume) Decne. He separated the two species of *Physostelma*, *P. wallichii* and *P. campanulatum*, based on differences in the pollen masses whilst suggesting the corolla and corona were similar. Hasskarl (1845), however, designated *Hoya campanulata* as the type of the monotypic genus *Cystidanthus* Hassk., leaving *P. wallichii* in *Physostelma*. Hasskarl emphasised the similarities of the corolla and corona of *Physostelma* and *Cystidanthus* but did not highlight any differences to justify the segregation of the two genera. Bentham & Hooker (1876) later placed *Physostelma wallichii* in synonymy of *Hoya campanulata* without comment. The synonymy was generally accepted by later authors who treated the taxon either as *Hoya campanulata* (King & Gamble, 1908; Rintz, 1978) or as *Physostelma campanulatum* (Hooker, 1885; Boerlage, 1891). Only Ridley (1900) recognised *Physostelma wallichii* as a separate taxon, but later treated it as a synonym of *Physostelma campanulatum* (Ridley, 1923). Lastly, *Physostelma wallichii* was considered a separate taxon by Burton (1996) and the combination *Hoya wallichii* (Wight) C.M. Burton was made. However, she incorrectly applied the name to material later identified as a new species endemic to Borneo, *Hoya*

*danumensis* Rodda & Nyhuus. This chain of events shows that researchers have long been unclear whether *Hoya wallichii* and *H. campanulata* are distinct from each other and, even when recognised as separate taxa, how the name *H. wallichii* should be correctly applied. For these reasons the endemic status of *Hoya wallichii* in Singapore and the fact that it appeared to have become extinct were long overlooked.

### **Distinction between *Hoya wallichii* and *Hoya campanulata***

We have examined the status of these two taxa by examination of original material and other herbarium specimens originally identified as either *Hoya wallichii* or *H. campanulata*, or were previously unidentified to species, in BM, BO, BRUN, FI, K, KEP, L, P, SAN, SAR, SING and SNP (Thiers, continuously updated). In addition we examined living material from across Sundaland, including recent observations in Peninsular Malaysia. We conclude that *Hoya wallichii* and *H. campanulata* are distinct species. *Hoya wallichii* has solitary flowers (two or three flowers may be present in each inflorescence but only one is open at a time) while *H. campanulata* has convex umbels with up to 30 flowers (Fig. 1); *H. wallichii* has a corolla 3–4 cm in diameter whereas that of *H. campanulata* is (1.5–)2–3 cm broad; *H. wallichii* has a corona that is purple with kidney-shaped lobes terminating in a short acuminate inner process while that of *H. campanulata* is white or cream-coloured and star-shaped with spreading, almost linear lobes (Fig. 2 A–D).

As the two species are easily distinguished, the confusion between them has primarily been caused by inaccuracies in the literature, starting with the description of *Physostelma wallichii*. The species was described as bearing 10 filaments and five anthers. The type specimen has typical *Hoya* filaments that are fused and form a tube, while the five anthers are alternate with the corona lobes. At the time of publication of *Physostelma wallichii* fewer than 30 species of *Hoya* had been described, with great variation in corona morphology. It may be possible that Wight interpreted the two guide rails subtending each anther as two filaments. No subsequent authors attempted to explain or justify the distinction between these two genera and, indeed, there is no possible explanation or justification. Eventually Bentham & Hooker (1876) concluded that there was no distinction between these two genera, combining them into *Hoya*, but they went too far in synonymising *Hoya wallichii* under *H. campanulata*, a surprising action which requires comment given the clear distinction between the two species. We speculate that the diagnostic characters of the corona were not actually examined in detail by Bentham & Hooker and most other authors. In Kew all herbarium specimens of *Hoya wallichii* have the corona hidden within the campanulate corolla. There is one specimen on which a detailed illustration of the corona is appended but this specimen was likely not seen by any of these authors as it was only found amongst undetermined material in the general collection (see further discussion below). This apparent lack of observation of the corona is evident in King & Gamble (1908) and Ridley (1923) because they include specimens of *Hoya wallichii* and *H. campanulata*, as well as specimens of two other species only recently described (*H. danumensis*

and *H. mappigera* Rodda & Simonsson), within their single species concept. These species all have thin leaves and a campanulate corolla but are clearly distinguishable in corona characters. Interestingly Ridley is the only author that correctly described *Physostelma wallichii* as having a red corona (Ridley, 1900), a character that he no longer mentioned in his later treatment (Ridley, 1923).

### Typification of *Hoya wallichii*

The collections that Wight examined were indicated in the protologue of *Physostelma wallichii* and were clarified in Noltie (2005) as ‘Singapore, Wallich, Wall Asclep. 130[A = Wall. Cat. 8171A. [?Malaya], herb. Finlayson, Wall. Asclep. 130[B = Wall. Cat. 8171B]’. Noltie (2005) did not locate any possible type material in E or K. Wight worked on specimens in his own ‘working herbarium’ sent from the East India Company (Noltie, 2005). The list of specimens he received can be found in Manuscript 1284, Linnean Society. These specimens usually bear a Herbarium Robert Wight Proper (HRWP) label and were in Wight’s private possession until 1871 (Noltie, 2005). The list includes ‘(Asclep) n 130: (a) Singapore Herb. Wall; (b) Herb Finl.’. Examination of the *Hoya* specimens in the main herbarium at Kew revealed an undetermined specimen with a HRWP label (Fig. 3B, C). This specimen bears the Wight number ‘130’ but no ‘A’ or ‘B’ and furthermore bears two labels in Wight’s handwriting with a manuscript description of *Physostelma wallichii* and a line drawing of the corona (Fig. 3C). As this specimen is part of the original material and represents a complete and well-preserved specimen belonging to Wight’s personal ‘working herbarium’ it is selected as the lectotype of *Hoya wallichii*. Two additional specimens labelled *Physostelma wallichii* are present in the East India Company Herbarium (better known as the Wallich Herbarium, K-W): Singapore, *Wallich 8171A* and *Finlayson in Herb. Wallich 8171B*, and can be considered syntypes. Both of them have ‘Ascl. 130a’ (a for *Wallich 8171A*; b for *Wallich 8171B*) pencilled on the lower left corner, probably in C.B. Clarke’s hand. Additionally *Wallich 8171A* is also pencilled ‘Ascl. 130a’ in the upper right corner by an unidentified hand.

It is possible that if the late 19th century and 20th century authors had had access to the HRWP specimen and been able to observe the corona characters *Hoya wallichii* would not have been synonymised with *H. campanulata* and much of the subsequent confusion would have been avoided.

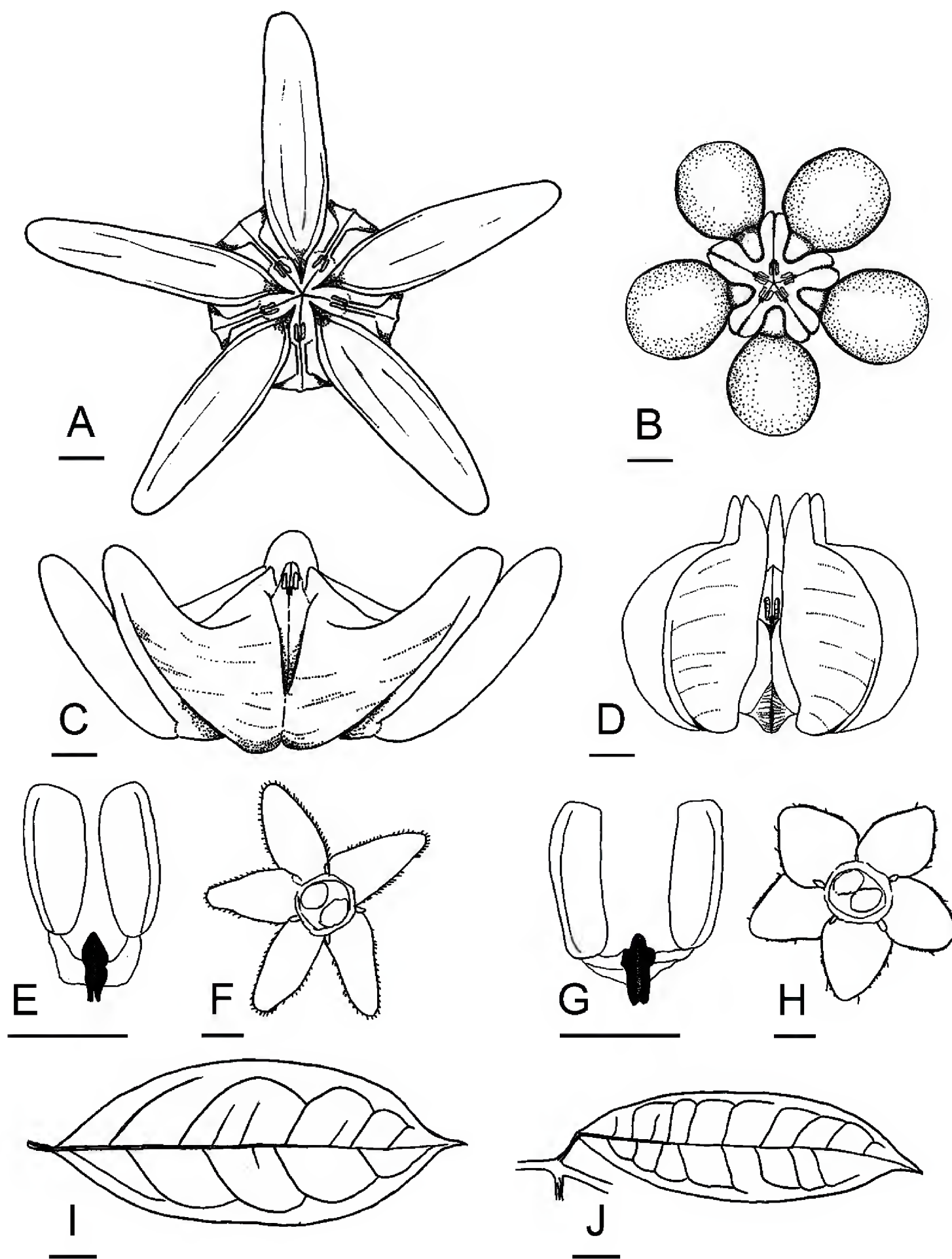
### Implications for conservation

As noted earlier, even after the existing herbarium material was carefully determined to species, there is no evidence of collections of *Hoya wallichii* made in Singapore after 1894. All of the recorded localities have been lost to development and recent survey work in still-forested areas of Singapore has not resulted in any new collections. *Hoya wallichii* favours primary forest where it grows in dappled shade on the ground or on

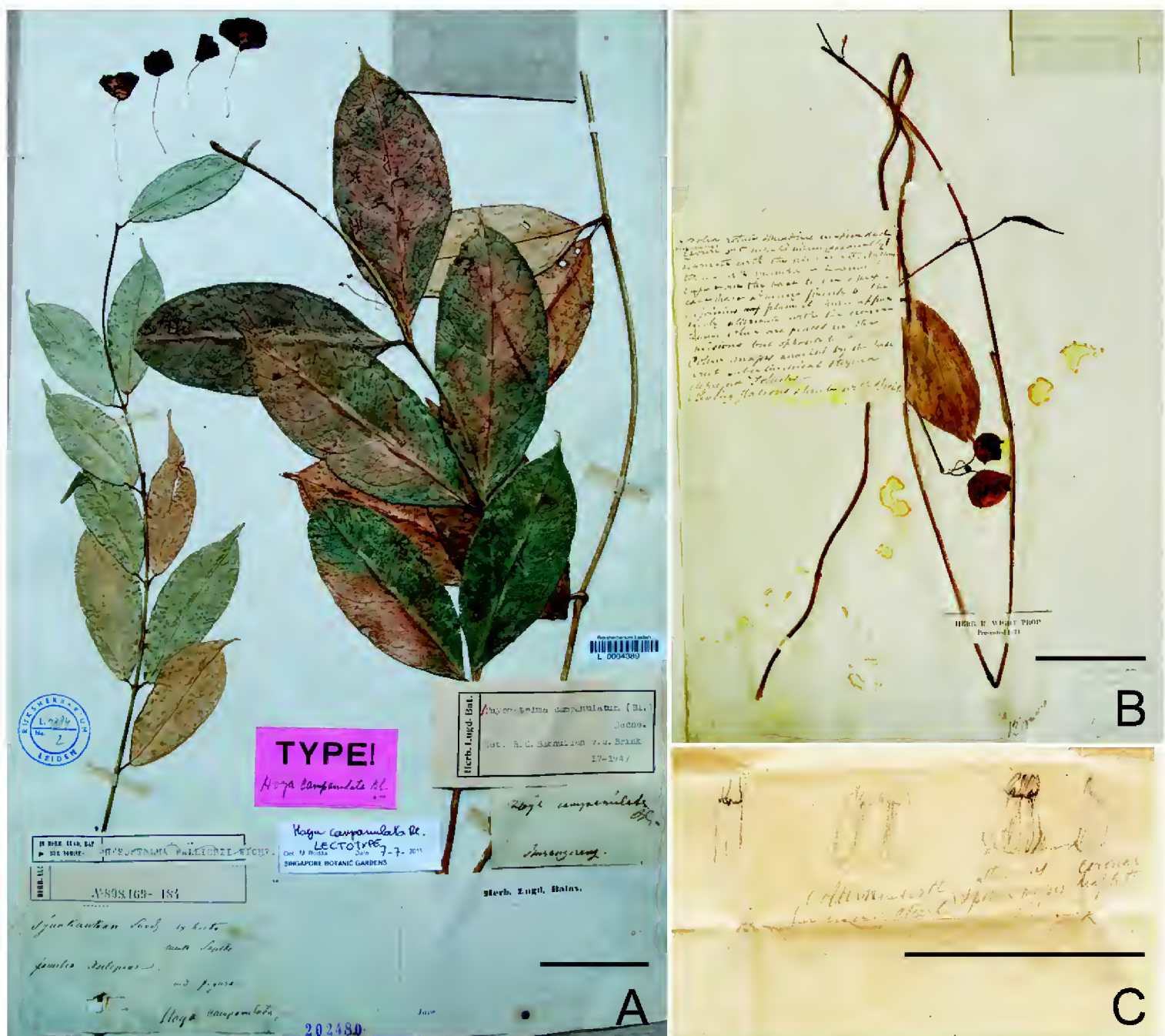




**Fig. 1.** Comparison between the inflorescences of *Hoya wallichii* and *H. campanulata*. **A.** *Hoya wallichii* *in situ* in Brunei, with a single flower. **B.** *Hoya campanulata*, cultivated at the Singapore Botanic Gardens, with an umbelliform inflorescence. (Photos: A, J. Henrot; B, M. Rodda)



**Fig. 2.** Morphological comparison between *Hoya campanulata* (left) and *Hoya wallichii* (right) **A, B.** Corona, from above. **C, D.** Corona, side view. **E, G.** Pollinarium. **F, H.** Calyx and ovaries. **I, J.** Leaf. (A, C, E, F, I *Hoya campanulata*, from [L0004389]; B, D, G, H, J *Hoya wallichii*, from [K000449753]. Scale: A, B, C, D, F, H: 1 mm; E, G: 500  $\mu$ m; I, J: 1 cm). Drawn by M. Rodda.



**Fig. 3. A.** The lectotype of *Hoya campanulata* in L [L0004389], bearing a label with [Tjungkankan] and [Java] in Blume's hand (label in the lower left corner of the sheet). **B.** Lectotype of *Hoya wallichii* in K [K000449753], bearing a [Herb. R. Wight Prop, Presented 1871] label and pencilled [(Wall Asclep. n.) 130]. The large manuscript label is a description of the species attributed to Wight. **C.** Drawing of the corona of *H. wallichii* found on the lectotype (Visible folded in the upper right corner of Fig. 3B). Scale: 5 cm. (Photos: M. Rodda, reproduced with the consent of the Royal Botanic Gardens, Kew and Naturalis, Leiden.)

moss-covered rocks. Suitable habitats may still be present in the remaining patches of primary forest in the Central Nature Reserves area and the search for *H. wallichii* and other rare or extinct *Hoya* species is still on-going. However, a specimen collected in 1939 in Johor, Malaysia (*Ngadiman s.n.* [SING0120876]), earlier identified as *Hoya campanulata*, and a collection made in Brunei in 2010 (*Henrot, J. JH/509*, BRUN), have been identified by us as *Hoya wallichii*. In addition the species was photographed in Johor in 2012 (Rodda & Henrot, 2013). We can conclude, therefore, that although *Hoya wallichii* is extinct in Singapore it is no longer to be considered globally extinct. A formal conservation assessment of Critically Endangered using IUCN (2012) methodology is given below.

*Hoya campanulata* is a widespread species in SE Asia, occurring from Peninsular Malaysia to Java but not in Borneo. It occurs up to 1600 m a.s.l. in Sumatra (*de Wilde & de Wilde-Duyffjes 18595*, L), but is largely absent at low altitudes. A formal conservation assessment of Least Concern using IUCN (2012) methodology is given below.

### Taxonomic treatment

*Hoya wallichii* (Wight) C.M.Burton, Hoya 18(1:2): 5 (1996). – *Physostelma wallichii* Wight, Contr. Bot. India 40 (1834). – TYPE: [Singapore] *Herb. R. Wight Prop.* [Wall Asclep. n.] ‘130’ (lectotype K [K000449753], designated here).

Semi-woody, slender, wiry terrestrial twiner or sub-shrub; latex white. **Leafy stems** cylindrical, 1.5–3 mm diameter, apically sparsely puberulent, older stems leafless, glabrous with waxy bark. **Internodes** (1–)2.5–5(–15) cm long, adventitious roots absent. **Leaves** opposite, petiolate; **petiole** flattened or channelled above, rugose below, 5–10 mm long, c. 2 mm wide, glabrous; **lamina** chartaceous, flexible, elliptic-lanceolate, 4.5–10 × (1.5–)2–3(–4) cm, widest in the central portion, apex apiculate-cuspidate, base cuneate, margin entire, penninerved, main vein depressed on adaxial surface, evident on abaxial surface, secondary veins 5–8 pairs, evident when dry, curved and anastomosing to form an intra-marginal nerve along the edge, branching at 70–80°(–90°) from main vein. **Inflorescences** with only one flower fully open at a time; **peduncles** terete, extra-axillary, perennial, bearing scars of previous flowerings, 1.5–3 cm long, c. 1.5 mm wide, glabrous; **pedicels** terete, 2–4 × c. 1 mm, glabrous, fruit-bearing pedicels more stout, c. 1.5 mm wide. **Calyx** c. 4 mm in diameter, **sepals** round to rhomboid, 1.5 × 1–1.5 mm, apex round, margins denticulate, sparsely ciliate; basal gland at the junction between the sepals c. 0.3 mm long. **Corolla** campanulate, membranaceous, 3–4 cm in diameter, white to cream-coloured, glabrous; **corolla lobes** fused with a central free triangular acute tip 5 × 3 mm. **Staminal corona** 5–6 mm high, 6–7 mm diameter, purple, lobes erect, kidney-shaped, c. 5 mm high, c. 2 mm wide, basally broadened into a swollen process with basal revolute margins, apically forming a single acuminate appendage c. 1.2 mm long, extending c. 2 mm above the anthers. **Pollinarium** (all measurements approx.) 800 µm long, pollinia oblong, 600 × 200 µm, apex and base round, **corpusculum** 300 × 170 µm, **caudicles** 200 µm long. **Ovary** bottle-shaped, c. 2 mm long. **Fruits** cylindrical follicles, developing singly, 12–20 cm long, 5–7 mm in diameter; **seeds** comose, spindle-shaped, 7–8 × c. 2 mm.

**Distribution.** Brunei, Peninsular Malaysia (Johor), Singapore (extinct).

**Additional specimens examined.** SINGAPORE: sin. loc., 1821 or 1822, *Wallich, N. 8171A* (syntype K-W [K000438428]); sin. loc., 4 Nov 1889, *Ridley, H.N. 2604* (BM); sin. loc., ex Hb. Finlayson, *Wallich, N. 8171B*, (syntype K-W [K000438429]); **Kranji:** 29 Nov 1889, *Goodenough, J.S. 2684* (SING [SING0120837]); 8 Jan 1890, *Ridley, H.N. s.n.* (SING

[SING0120836]); **Tampines:** River, Feb 1894, *Ridley, H.N. s.n.* (SING [SING0012208]); **Sarimbun:** 2 Oct 1894, *Mat 6691* (SING [SING0012207]).

BRUNEI: **Belait:** Labi, 2 Oct 2010, *Henrot, J. JH/509* (BRUN).

MALAYSIA: **Johor:** Pontian, Pengkalan Raja, 25 Jun 1939, *Ngadiman, I. s.n.* (SING [SING0120876]).

*Provisional IUCN conservation assesement.* Critically Endangered (CR B2ab(iii)). Previously believed to be endemic to Singapore and presumed extinct, it is now only known from two quite disjunct localities in Johor and Brunei. In Johor it is known from a collection from 1939 in Pengkalan Raja, too long ago to be considered in a new conservation assessment without confirmation the species still occurs there, and a recent photograph. The condition of the locality in Brunei is uncertain but the locality of the recently photographed plant in Johor is on the edge of a forest park that is quite disturbed.

*Hoya campanulata* Blume, *Bijdr.* 1064 (1826). – *Physostelma campanulatum* (Blume) Decne. in A.DC., *Prod.* 8: 633 (1844). – *Cystidanthus campanulatus* (Blume) Hasskarl, *Tijdschr. Natuurl. Gesch. Physiol.* 10: 125 (1843). – TYPE: Indonesia, Java, ‘ex horto, mento septembre, Tjunkankan, Burangarang’ (lectotype L [L0004389], designated here).

*Cystidanthus laurifolius* Blume, *Mus. Bot.* 1(4): 57 (1849). – *Hoya cystiantha* Schltr., *Bot. Jahrb. Syst.* 50: 127 (1913). – TYPE: Indonesia, Sumatra, ‘*Cystidanthus laurifolius* Bl’, *Korthals s.n.* (lectotype L [L0004387], designated here; isolectotype L [L0004388]). – EPITYPE: Indonesia, Sumatra, Ketambe, Aceh Province, South edge of Taman Gunung Leuser, *Green, T. 99009* (epitype BISH [BISH1016621], designated here).

Semi-woody, slender, wiry terrestrial or epiphytic twiner or sub-shrub; latex white. **Leafy stems** cylindrical, 1.5–3 mm diameter, apically sparsely puberulent, older stems leafless, glabrous, rugose. **Internodes** 3–5(–18) cm long, adventitious roots absent, unless in direct contact with substrate. **Leaves** opposite, petiolate; **petiole** channelled above, rugose below, 4–8 mm long, c. 2 mm wide, glabrous; **lamina** chartaceous, flexible, elliptic-lanceolate, 5–7(–12) cm by (2–)3–5 cm, widest in the central portion, apex apiculate-cuspidate, base cuneate, margin entire, penninerved, main vein depressed on adaxial surface, evident on abaxial surface, secondary veins 4–6(–8) pairs evident when dry, curved and anastomosing to form an intra-marginal nerve along the edge, branching at 50–60° from main vein. **Inflorescences** pseudo-umbelliform, convex, positively geotropic, up to 20-flowered; **peduncles** terete, extra-axillary, perennial, bearing scars of previous flowerings, about 1–2(–5) cm long, c. 1.5 mm wide, glabrous; **pedicels** terete, 3–4 cm by c. 1 mm, glabrous, fruit-bearing pedicels more stout, up to 2 mm wide. **Calyx** c. 5 mm in diameter, **sepals** lanceolate to oblong, 2–2.5 × 1–1.5 mm, apex rounded, margins ciliate; basal gland at the junction between the sepals c.

0.4 mm long. *Corolla* campanulate, membranaceous, (1.5–)2–3 cm in diameter, white to cream-coloured, sometimes yellow or pink-flushed, glabrous; *corolla lobes* laterally fused with a central free acute triangular tip, 2 × 2 mm. *Staminal corona* star shaped, 3–4 mm high, 7–10 mm diameter, white, corona lobes boat-shaped, terete, 4.5–5.5 mm long, 1.5–2 mm broad, basally presenting revolute margin, outer process ascending; basal process laterally spreading, when viewed perpendicularly to the corona forming a disk of 3–4 mm radius. *Pollinarium* (all measurements approx.) 1 mm long, *pollinia* oblong, 800 × 230 µm, apex and base rounded to truncate, *corpusculum* 280 × 130 µm, *caudicles* 150 µm long. *Ovary* bottle-shaped, c. 1.5 mm long. *Fruits* cylindrical follicles, developing singly but up to 5 for each inflorescence, 12–18 cm long, 5–7 mm in diameter; *seeds* comose, spindle-shaped, 4–5 × c. 1 mm.

*Distribution.* Indonesia (Java, Sumatra), Peninsular Malaysia, Singapore (extinct).

*Additional specimens examined.* Unlocalised, Cult. Kew, ‘Bot. Mag. T 4545’ (K); label unreadable (L [L0796650]), (L [L0796647]).

SINGAPORE: **Tampines:** November 1893, *Almeida, E.D. s.n.* (SING [SING0012210]).

MALAYSIA: **Unknown locality:** *King’s collector 2587*, fragment (K); *Wray, L.W. 3139*, fragment (K); *Wray, L.W. 4041*, fragment (K). **Selangor:** Ulu Gombak, 17 mile, 25 Oct 1937, *Md. Nur 34219* (A n.v., P [P00700460], SING); Sungai Rangkap, 500 ft, 23 May 1976, *Rintz, R.E. RER58* (KEP [KEP160389]); Sungai Semangkok, 2200 ft, 27 Sep 1976, *Rintz, R.E. RER124* (KEP [KEP160391]); Sungai Semangkok, 2700 ft, 25 Sep 1976, *Rintz, R.E. RER119* (KEP [KEP160390]); 15 mile Sungai Gombak, River edge in lowland forest, 700 ft, *Rintz, R.E. RER22* (L [L0796665], KEP [KEP160393]); Klang Gates, 22 Jul 1927, *Strugnell, E.F. 13033* (KEP [KEP160399]). **Perak:** Larut, 300–380 ft, Jan 1883, *King, G. 3849* (K); Thaiping Hills, Feb 1900, *Ridley, H.N. s.n.* (SING [SING0120878]); Tenok Road, Tapah, *Ridley, H.N. s.n.* (SING). **Negeri Sembilan:** Jelevu, Berembun F.R., Jeram Toi, Riverside trail, Across river, 2°51’40”N 102°00’58”E, 332 m a.s.l., 10 Apr 2008, *Yat, T.L. FRI57949* (KEP [KEP159153]). **Malacca:** 1898, *Ridley, H.N. 9712* (SING).

INDONESIA: **Java sin. loc.:** s.d., *s.coll.* ‘misit Blume’, 1836 (P [P00700459]); 25 Jun 1848, *Zollinger, H. s.n.* (P [P00700458]); s.d., *Blume s.n.* (L [L0796663]); s.d., *s.coll. s.n.* (L [L0796664]); 1878, *s.coll. s.n.* (L [L0796649]); s.d., *s.coll. s.n.* (L [L0796652]); *ex herb. Blume* (L [L0796648]); s.d., *s.coll. s.n.* (L [L0796651]); s.d., *s.coll. s.n.* (L [L0796653]). **West Java:** Buitenzorg, ‘Kikandel’, *Lecomte, P.H. & Finet, A. s.n.* (P [P00218897]); Buitenzorg, 1 Sep 1926, *herb d’Alleizette 4853* (L [L0796646]); ‘*ex horto, mento septembre, Tjunkankan Burangarang*’ (L [L0004389]); ‘*Tjunkankan*’ (L [L0004390]); Preanger, Guenueng Besar Tjigagap, 1000 m a.s.l., 6 Nov 1917, *Bakhuizen Van den Brink R.C. 2946* (L [L0796655]); Preanger, Tjadas Malang, 1000 m, 25 Mar 1917, *Bakhuizen Van den Brink R.C. 2896* (L [L0796656]); Batavia, 2 Mar 1929, *Bakhuizen Van den Brink R.C. 7176* (L [L0796654]); Tjiandjun Distr. Gunung Boser near Tjidadep, 1100 m a.s.l., May 1968, *Kostermans, A.J.G.H. s.n.* (L [L0794340]). **Sumatra sin. loc.:** s.d., *s.coll. s.n.* (syntype L [L0004386]); s.d., *Forbes, H.O. 2257*, fragment (K); s.d., *s.coll. s.n.* (L [L0796657]); s.d., *s.coll. s.n.* (L [L0796658]); s.d., *s.coll. s.n.* (L [L0796659]); s.d., *Wray, L.W. 1841* (SING [SING0120872]). **Aceh:** Gajolanden, Goempang to Kongke, c. 800 m., 12 Mar 1937, *van Steenis, C.G.G.J. 9759* (K, L [L0796660]); Gunung Leuser Nature Reserve, Camp Simpang and vicinity, 3–5 km upstream Lau Ketambe, c. 33 km NW of Kutatjane, 20 Jul 1972, *de Wilde, W.J.J.O. & de Wilde-Duyffjes, B.E.E. 13837* (L [L0794352]); Gunung Leuser Nature Reserve, Ketambe, valley of Lau Alas, near tributary of Lau Ketambe, c.

35 km NW of Kutatjane, 200–400 m alt., *de Wilde, W.J.J.O. & de Wilde-Duyffes, B.E.E. 12166* (L [L0794348]), *12167* (L [L0794347]); Gunung Leuser Nature Reserve, Ketambe, valley of Lau Alas, near tributary of Lau Ketambe, c. 35 Km NW of Kutatjane, 200–400 m alt., 29 May 1972, *de Wilde, W.J.J.O. & de Wilde-Duyffes, B.E.E. 12455* (L [L0794347]); P. T. Hargas logging concession, c. 2°43'N 97°34', c. 10 m alt., 3 Aug 1985, *de Wilde, W.J.J.O. & de Wilde-Duyffes, B.E.E. 20578* (L [L0794360]); Upper Mamas River valley expedition, c. 18 km W of Kutacane, c. 3°25'N 97°40'E, 1600 m alt., 22 Jun 1979, *de Wilde, W.J.J.O. & de Wilde-Duyffes, B.E.E. 18595* (L [L0794349]). **West Sumatra:** near Mount Sigirik within Bukit Sebelah nature reserve, 500 m alt., 15 May 1983, *Laumonier, Y. TFB 4379* (L [L0794350]); Taram, East of Pajakumbuh, region of river Tjampo, 500–1000 m alt., *Mundji 340* (L [L0796661]); Padang Highlands, 1200 m, 10 Oct 1919, *Batten Pool, A.H. s.n.* (SING [SING0121892]).

*Provisional IUCN conservation assesment.* Least Concern (LC). This species is widespread and, despite the paucity of very recent collections, is still locally common and not under any known threat (MR pers. obs.).

*Notes.* Blume (1826) did not cite any specimens in the protologue of *Hoya campanulata* but specified ‘in fruticetis montanis Javae occidentalis’, flowering ‘toto anno’ and gave the local name as ‘Tjunkankan’. A specimen labelled *Hoya campanulata* Blume [L0004389], bearing a label with [Tjunkankan] and [Java] in Blume’s hand has been found in L (Fig. 3). This is the only specimen found with elements from the protologue. The specimen is well preserved with both leafy shoots and flowers and is therefore designated as the lectotype of *Hoya campanulata*.

The original description of *Cystidanthus laurifolius* Blume, later *Hoya cystiantha* Schltr., is similar to *H. campanulata* in all aspects except with smaller flowers (Blume, 1848). *Hoya campanulata* flowers are very variable in size across its range, without any other morphological discontinuity, and therefore *H. cystiantha* is here treated as a synonym of *H. campanulata*. *Cystidanthus laurifolius* (and its replaced synonym *Hoya cystiantha*) was neotypified by Green (2011) where he stated that no extant original material could be traced. Blume (1849) only mentioned ‘In Sylvis Sumatris’. In L we found three specimens from Sumatra annotated in Blume’s handwriting as *Cystidanthus laurifolius*. Two of these were collected by Korthals [L0004387 and L0004388], and are likely to be duplicates, while the third is from an unknown collector [L0004386]. We believe these to be original material. All three specimens lack complete flowers but [L0004387] has an intact calyx and, being the least sterile specimen, is therefore selected as lectotype for the name. As the lectotype is nevertheless almost sterile we select Green’s neotype (*Green 99009* [BISH1016621]) as epitype for *Cystidanthus laurifolius* Blume.

**ACKNOWLEDGEMENTS.** Jana Leong-Škorničková was the handling editor for this manuscript. This research received support from the National Parks Board (Singapore) that sponsored herbarium visits in Asia and Europe (MR & DJM). We thank the curators of the BM, BO, BRUN, FI, K, KEP, L, P, SAN, SAR, SNP and SING herbaria for allowing access and/or for providing high quality images of herbarium specimens. We thank J. Henrot for providing

photographs of *Hoya wallichii in situ* in Brunei. Two anonymous reviewers and Jana Leong-Škorničková are thanked for suggesting improvements to the manuscript.

## References

- Bentham, G. & Hooker, J.D. (1876). *Physostelma*. In: Bentham, G. & Hooker, J.D. (eds) *Genera Plantarum* 2. P. 777. London: L. Reeve & Co.
- Blume, C.L. (1826). *Hoya*. In: Blume, C.L. (ed) *Bijdr. Fl. Ned. Ind.* 16. Pp. 1062–1065. Batavia: Ter Lands Drukkerij.
- Blume, C.L. (1848). *Asclepiadeae*. In: Blume, C.L. (ed) *Rumphia* 4. Pp. 29–35. C.G. Leiden: Sulpke.
- Blume, C.L. (1849). *Cystidianthus*. In Blume, C.L. (ed) *Mus. Bot.* 1. P. 57. Lugduni-Batavorum: apud E.J. Brill (Ex typographeo J.G. la Lau)
- Boerlage, J.G. (1891). *Asclepiadaceae*. In: Boerlage, J.G. (ed) *Handl. Fl. Ned. Ind.* 2. Pp. 401–442. Leiden: E.G. Brill.
- Burton, C.M. (1996). A tentative alternative arrangement of *Hoya* sections. *Hoyan* 18(1:2): 2–6.
- Chong, K.Y., Tan, H.T., & Corlett, R.T. (2009). *A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species*. 273 p. Singapore: Raffles Museum of Biodiversity Research, National University of Singapore.
- Decaisne, J. (1844). *Hoya*. In: De Candolle, A. (ed) *Prodromus* 8. Pp. 634–640. Paris: Fortin, Masson et sociorum.
- Green, T. (2011). Designation of a neotype for a species of *Hoya* from Sumatra: *Hoya cystiantha* Schlechter. *Asklepios* 111: 27–28.
- Hasskarl, J.C. (1845). *Plantarum Javanicarum aut Novarum aut Minus Cognitarum Adumbrationes*. *Flora* 16: 225–256.
- Hooker, J.D. (1885). *Physostelma*. In: Hooker, J.D. (ed) *The Flora of British India* 4. Pp. 62–63. London: L. Reeve & Co.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. Gland, Switzerland and Cambridge, UK: IUCN.
- Kiew, R. & Turner, I.M. (2003). Are any plants endemic to Singapore? *Gard. Bull. Singapore* 55: 173–184.
- King, G. & Gamble, J.S. (1908). *Hoya*. In: King, G. & Gamble, J.S. (eds) *Flora of the Malayan Peninsula. J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist.* 74:559–580.
- Leong-Škorničková, J. & Boyce, P.C. (2015). *Hanguana* in Singapore demystified: an overview with description of three new species and a new record. *Gard. Bull. Singapore* 67: 1–28.
- Leong-Škorničková, J., Thame, A. & Chew, P.T. (2014). Notes on Singapore native Zingiberales I: A new species of *Zingiber* and notes on the identities of two further *Zingiber* taxa. *Gard. Bull. Singapore* 66: 153–167.
- Noltie, H.J. (2005). *The Botany of Robert Wight. Regnum Vegetabile* 145. Ruggell: A.R.G. Gantner Verlag.
- Ridley, H.N. (1900). The Flora of Singapore. *J. Straits Branch Roy. Asiat. Soc.* 33: 27–196.
- Ridley, H.N. (1923). *Hoya*. In Ridley, H.N., *The Flora of the Malay Peninsula* 2. Pp. 393–402. London: L. Reeve & Co.
- Rintz, R.E. (1978). The Peninsular Malaysian species of *Hoya* (Asclepiadaceae). *Malayan Nat. J.* 30: 467–522.
- Rodda, M. (2015). Two new species of *Hoya* R.Br. (Apocynaceae, Asclepiadoideae) from Borneo. *PhytoKeys* 53: 83–93.



- Rodda, M. & Henrot, J. (2013). *Hoya wallichii*: Confused, extinct, and rediscovered. *Gardenwise* 41: 18–19.
- Rodda, M. & Nyhuus, T. (2009). *Hoya danumensis*, a new species of *Hoya* (Apocynaceae, Asclepiadoideae) from Borneo. *Webbia* 64: 163–167.
- Tan, B.C., Ho, B.-C. & Seah, B.K.-B. (2004). Two new moss species, *Trichosteleum fleischeri* and *Splachnobryum temasekensis*, from Singapore. *J. Hattori Bot. Lab.* 96: 1–7.
- Thiers, B. (continuously updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/> (accessed on 24 Jun. 2016)
- Wight, R. (1834). *Contributions to the Botany of India*. London: Parbury & Co.
- Wanntorp, L., Kocyan, A. & Renner S.S. (2006a). Wax plants disentangled: A phylogeny of *Hoya* (Marsdenieae, Apocynaceae) inferred from nuclear and chloroplast DNA sequences. *Molec. Phylogenet. Evol.* 39: 722–733.
- Wanntorp, L., Kocyan, A., Van Donkelaar, R. & Renner, S.S. (2006b). Towards a monophyletic *Hoya* (Marsdenieae, Apocynaceae): Inferences from the chloroplast *trnL* region and the *rbcL-atpB* spacer. *Syst. Bot.* 31:586–596.
- Wanntorp, L., Gotthardt, K. & Muellner, A.N. (2011). Revisiting the Wax Plants (*Hoya*, Marsdenieae, Apocynaceae): Phylogenetic tree using the *matK* gene and *psbA-trnH* intergenic spacer. *Taxon* 60: 4–14.
- Wanntorp, L., Grudinski, M., Forster, P.I., Muellner-Riehl, A.N. & Grimm, G.W. (2014). Wax plants (*Hoya*, Apocynaceae) evolution: Epiphytism drives successful radiation. *Taxon* 63: 89–102.



## Two new records for the Lamiaceae of Singapore

R.P.J. de Kok<sup>1</sup>, S. Sengun<sup>2,3</sup> & G.L.C. Bramley<sup>3</sup>

<sup>1</sup>Honorary Research Associate, Singapore Botanic Gardens,  
National Parks Board, 1 Cluny Road, Singapore 259569  
dekokrogier@gmail.com

<sup>2</sup>Birkbeck, University of London, Malet St, London WC1E 7HX, U.K.

<sup>3</sup>Royal Botanic Gardens Kew, Richmond, Surrey TW9 3AE, U.K.

**ABSTRACT.** The species of Lamiaceae have recently been revised for Singapore. In total 44 species in 21 genera are recorded, of which 23 species are native, an additional five are probably native, and 16 are non-native species which have naturalised in Singapore. One new record for Singapore has been found (*Vitex rotundifolia*) and one species reinstated (*Callicarpa pentandra*) after being ignored for over a hundred years.

**Keywords.** *Callicarpa pentandra*, conservation, distributions, *Vitex rotundifolia*

### Introduction

The Lamiaceae (Mint Family) is of major ecological and economic importance in Southeast Asia. It includes major (*Gmelina* L. & *Tectona* L.f.) and minor (*Teijsmanniodendron* Koord. and *Vitex* L.) timber groups. It is important horticulturally (*Clerodendrum* L. and its close relatives), culinarily (*Mentha* L. and *Ocimum* L.) and medicinally (*Vitex*). As a consequence, members of the family are often cultivated and have been moved around the region, in some case over many centuries. Taxonomically the family is complex with many species-rich genera, some of which have undergone major nomenclatural changes in the last 10 years (De Kok, 2007, 2008, 2012, 2013; Bramley, 2009; De Kok et al., 2009; Wearn & Mabberley, 2011). Worldwide, the family consists of around 236 genera and about 7200 species (Harley et al., 2004), while in the *Flora Malesiana* region 50 genera with 302 species are recorded (Bramley et al., in press). In the latest checklist for Singapore, 71 species in 29 genera were recorded (Chong et al., 2009) but this included 25 species and 12 genera known only in cultivation. Since then a number of genera have been revised and, as a consequence, many names have been reduced into synonymy and a few new species have been recognised. In addition, a number of genera have been investigated using molecular phylogenetic techniques, which has led to some genera being lumped together (e.g. Bramley et al., 2009), while others have been split (e.g. Yuan et al., 2010).

One of the key problems in this study has been how to determine if a species is native or naturalised in Singapore. Thanks to the taxonomic work done by several authors in the last 10 years on a series of genera, our understanding of the distribution of Lamiaceae taxa throughout Southeast Asia is much improved. This has resulted in

a change in opinion on whether a number of species are native or introduced. A clear example of this is *Gmelina asiatica* L., which was thought to be native in Singapore (Chong et al., 2009), but is now considered to be native to India, Thailand and Southern China, but cultivated and naturalised throughout the Southeast Asian region (De Kok, 2012). However, it is clear from looking at herbarium specimens and the available literature, that for some species this cannot always be satisfactorily established. For instance, some species of *Clerodendrum* and *Ocimum* have been moved around so much in the past that it is often impossible now to determine their original native distribution (see Bramley et al., in press).

The combination of recent taxonomic and systematic studies has established that there are 44 species in 21 genera in Singapore. Of these, 23 species are native, an additional five are probably native, and 16 are non-native species which have naturalised. These will be enumerated in the forthcoming *Flora of Singapore* account (De Kok & Bramley, submitted).

### Changes to the species list

The number of species now recognised as growing in Singapore has decreased. This can be attributed in part to a reduction in species to synonymy (see Bramley et al., in press). A good example is the genus *Premna* L., where three names (*Premna corymbosa* Rottler & Willd., *P. foetida* Reinw. ex Blume and *P. punctulata* C.B. Clarke) have been placed in the synonymy of *P. serratifolia* L. (De Kok, 2013). In addition, only one name has been added to the list due to a species being split. This is the recognition of *Ocimum x africanum* Lour. as distinct after previously being placed in synonymy of *Ocimum americanum* L. (Suddee et al., 2005).

The number of genera has also changed. For instance, both *Hyptis* Jacq. and *Clerodendrum* L. have been split into several distinct genera: *Hyptis* is now recognised as three genera in Malesia (*Hyptis*, *Cantinoa* Harley & Pastore and *Mesosphaerum* P. Browne – see Harley & Pastore, 2012), and *Clerodendrum* also as three genera in Malesia (*Clerodendrum*, *Rothea* Raf. and *Volkameria* L. – see Yuan et al., 2010).

Only two species have been added to the Singapore checklist. *Callicarpa pentandra* Roxb. was previously recorded by Ridley in 1900 since when it has been entirely omitted from any mention in the Singapore flora. We, therefore, treat it here as effectively a new record. *Vitex rotundifolia* L.f. has never previously been recorded for Singapore.

### Conservation

In the last 200 years Singapore has lost 99.8% of its primary forests and this deforestation has had a particularly bad impact on its coastal habitats (39% species loss), but a lesser impact on inland forests (29% species loss) and open vegetation (5% species loss) (Turner et al., 1994). In terms of life forms, over the same period, 19% of trees, 34%

of shrubs, 17% of herbs, 23 % of climbers and 62% of epiphytic species have been lost (Turner et al., 1994). In the Lamiaceae, 33% of coastal species, 45% of inland species and 25% of open vegetation species are presumed extinct. This translates into the loss of 28% of its trees, 57% of its shrubs, and all of its true climbers. However, all of its herbs have survived.

In Chong et al.'s 2009 checklist, all native species were given a national IUCN conservation assessment, while those deemed non-native were designated as cultivated, casual or naturalised (Chong et al., 2009). In our study native species as accepted in the *Flora of Singapore* (De Kok & Bramley, submitted) and not accounted for in Chong et al. (2009) are given a national IUCN conservation assessment.

From Table 1 it is clear that in general, the numbers of nationally extinct and Critically Endangered species have decreased, while the number of species of least concern has increased. This is mainly due to the fact that some of the presumed extinct species in Chong et al. (2009) have now been placed in synonymy of more common species. Also, some species which were previously thought to be introduced have now been reclassified as native and Least Concern.

**Table 1.** Difference in the number of native species for each category in national IUCN conservation assessments between the 2009 checklist (Chong et al., 2009) and the as-yet unpublished *Flora of Singapore* account (De Kok & Bramley, submitted). LC = Least Concern; VU = Vulnerable; EN = Endangered; CR = Critically Endangered; EX = Extinct.

Local IUCN assessments	Chong et al., 2009	De Kok & Bramley, submitted
Least Concern (LC)	5	7
Vulnerable (VU)	3	2
Endangered (EN)	2	3
Critically Endangered (CR)	4	3
Extinct (EX)	9	7

### New Records for Singapore

*Callicarpa pentandra* Roxb., Fl. Ind. 1: 409 (1820); Moldenke, Phytologia 50: 365 (1982); Bramley, Bot. J. Linn. Soc. 159: 443 (2009). – *Geunsia pentandra* (Roxb.) Merr., Philipp. J. Sci. C11: 309 (1916). – TYPE: Indonesia, Moluccas, *collector uncertain* (lectotype G-DC [G00312486], designated in Bramley (2013)). (Fig. 1)

*Geunsia farinosa* Blume, Cat. Gew. Buitenzorg 12 (1823); Ridl., Fl. Singapore 96 (1900). – *Callicarpa pentandra* Roxb. forma *farinosa* (Blume) Bakh., Bull. Jard. Bot. Buitenzorg, sér. III, 3: 13 (1921). – TYPE: Indonesia, *Blume s.n.* (holotype L).

*Geunsia farinosa* Blume var. *callicarpoides* H.J.Lam ex Moldenke, Phytologia 50: 220 (1982). – TYPE: Indonesia, Kalimantan, *collector unknown* (holotype L).

*Callicarpa cumingiana* Schauer in A.DC., Prodr. 11: 644 (1847). – *Geunsia cumingiana* (Schauer) Rolfe, Journ. Linn. Soc., Bot. 21: 315 (1884). – *Callicarpa pentandra* var. *cumingiana* (Schauer) Bakh., Bull. Jard. Bot. Buitenzorg, sér. III, 3: 16 (1921). – TYPE: Philippines, *Cuming 1707* (lectotype K, designated in Bramley (2013); isolectotype P).

*Callicarpa hexandra* Teijsm. & Binn., Cat. Hort. Bot. Bogor 410 (1863). – *Geunsia hexandra* (Teijsm. & Binn.) Koord., Meded. Lands Plantentuin 19: 559 (1898). – *Callicarpa pentandra* Roxb. forma *hexandra* (Teijsm. & Binn.) Bakh., Bull. Jard. Bot. Buitenzorg, sér. III, 3: 13 (1921). – TYPE: Celebes [Sulawesi], Menado, Minahassae, *de Vriese & Teijsmann s.n.*, (lectotype L, designated in Bramley (2013)).

*Geunsia hexandra* (Teijsm. & Binn.) Koord. var. *macrophylla* Moldenke, Phytologia 49: 430 (1981). – TYPE: Malaysia, Sabah, Tawau district, Luasong, 25 February 1979, *Fedilis & Sumbing SAN89702* (holotype SAN; isotype K).

*Callicarpa affinis* Elmer, Leaflet Philipp. Bot. 3: 864 (1910). – TYPE: Philippines, Mindanao, Davao district, Todaya (Mt Apo), June 1909, *Elmer 11102* (lectotype K, designated in Bramley (2013); isolectotypes GH, L, L, NY, US).

*Callicarpa serrulata* (Hallier f.) Govaerts, World Checklist Seed Pl. 3(1): 12 (1999). – *Geunsia serrulata* Hallier f., Meded. Rijks-Herb. 37: 27 (1918). – TYPE: Borneo, Gebiet des Sambasstromes, 30 October 1893, *Hallier 801* (holotype L; isotypes BO x3).

*Geunsia serrulata* forma *anisophylla* (Hallier f.) Moldenke, Phytologia 50: 378 (1982). – *Geunsia anisophylla* Hallier f., Meded. Rijks-Herb. 37: 29 (1918). – TYPE: Borneo, Müllergebirge, 14 March 1894, *Hallier B2741* (holotype L; isotypes BO x3).

*Callicarpa subternata* (Hallier f.) Govaerts, World Checklist Seed Pl. 3(1): 12 (1999). – *Geunsia subternata* Hallier f., Meded. Rijks-Herb. 37: 25 (1918). – TYPE: Borneo, Sungei Tikung, November 1912, *Amdjah 973* (holotype L; isotype BO).

*Geunsia hookeri* Merr., Philipp. J. Sci. 7: 342 (1912). – TYPE: Philippines, Cebu, *Cuming 1773* (lecto K, designated in Bramley (2013); isolectotypes GH, K, L).

*Callicarpa weberi* Merr., Philipp. J. Sci. 12: 298 (1917). – TYPE: Philippines, Bancalan Island, 26 September 1916, *Weber 68* (lectotype A, designated in Bramley (2013)).

*Callicarpa longivillosa* Merr., Philipp. J. Sci. 17: 313 (1920). – TYPE: Philippines, Mindanao, Surigao prov., 19 April 1919, *Ramos & Pascasio Bur. Sci. 34538* (lectotype K, designated in Bramley (2013); isolectotypes BM, BO).



**Fig. 1.** *Callicarpa pentandra* Roxb. **A.** Habit. **B.** Inflorescences. (Photos: G. Bramley from Lambir, Sarawak)

*Callicarpa pentandra* Roxb. var. *paloensis* (Elmer) Bakh. forma *furfuracea* Bakh., Bull. Jard. Bot. Buitenzorg, sér. III, 3: 15 (1921). – *Geunsia furfuracea* (Bakh.) Moldenke, Amer. J. Bot. 32: 612 (1945). – TYPE: Indonesia, Celebes [Sulawesi], Kp. Tapalang Mamoedjoe, 4 August 1912, *Van Vuuren & Noerkas* 425 (lectotype BO, designated in Bramley (2013); isoelectotypes K, L).

*Geunsia cumingiana* (Schauer) Rolfe var. *pentamera* H.J.Lam, Verbenaceae Malayan Archipel. 36 (1919). – TYPE: Philippines, Daraga, Com. d.l. Fl. for. no 844 (syntype not found); New Guinea, Hollandia, *Gjellerup* 416a 416b, 416c (syntypes all BO not found); Stephansort, *Nyman* 52 (syntype BO not found); Kaiser Wilhelmsland, *Weinland* s.n. (syntype BO not found).

*Callicarpa pentandra* var. *cumingiana* (Schauer) Bakh. forma *dentata* Bakh., Bull. Jard. Bot. Buitenzorg, sér. III, 3: 17 (1921). – *Callicarpa cumingiana* var. *dentata* (Bakh.) Moldenke, Phytologia 5: 8 (1954). – TYPE: Java, Noesa Kembangan, *Backer* 4611 (lectotype BO, designated in Bramley (2013); isoelectotype BO).

*Callicarpa ridleyi* S.Moore, J. Bot 63 (Suppl.): 80 (1925). – TYPE: Java, Mt Salak, November 1879, *Forbes* 272 (holotype BM).

*Callicarpa pullei* (H.J.Lam) Govaerts, World Checklist Seed Pl. 3: 12 (1999). – *Geunsia pullei* H.J.Lam, Verben. Malay. Archip. 35 (1919). – TYPE: West Papua [West Irian], nr Kloofbivak, *Pulle* 261 (holotype L; isotypes BO, Z).

**Shrub or tree** to 20 m, DBH 2–35 cm; outer bark light brown, ± smooth, inner bark yellowish, fibrous. **Young branches/twigs** with a dense indumentum of brown plumose or short-branched hairs, often farinose, or longer, patent hairs that appear simple but have numerous short branches at the base, also with yellow sessile glands. **Leaves** often with apparently alternate leaves between opposite pairs, narrowly elliptic to elliptic to narrowly ovate to almost ovate, 11–29 × 4–15 cm, margins ± entire to shallowly dentate, apex markedly to shortly acuminate, base acute to attenuate, rarely almost rounded, truncate or cordate, upper surface variable, either ± glabrous, or with hairs present along the midvein only, or with simple hairs and hairs that are branched near the base, or farinose, with scattered branched hairs, these present especially when young, lower surface variable, either with an indumentum of short-branched hairs on the venation only (including tertiary), or on the lamina and the venation, forming a raised layer but not obscuring the lamina surface, or with a dense pale coloured indumentum of matted plumose hairs on the lamina, often the individual hairs not visible to the naked eye, in this case the leaves discoloured, in all cases also with yellow sessile glands, occasionally peltate scales present either side of the midrib towards the leaf base; petioles 1.5–3.5 cm, indumentum as twigs. **Inflorescence** axillary, sometimes appearing terminal, peduncles 40–90 mm long, indumentum as stem; pedicels 2–2.5 mm long, indumentum as stems; bracts and bracteoles inconspicuous, linear, 0.2–10 mm long. **Calyx** cupular, 1–2 (2.5–3) mm long, ± truncate or with (4)5(6) shallow triangular lobes, outer surface densely covered with short-branched or ± plumose hairs, in the latter case the surface obscured, also with yellow sessile glands and occasional peltate scales, inner surface ± glabrous. **Corolla** purple, sweetly scented, 4–6 mm long, divided into (4)5(6) lobes, 1–2 mm long, often reflexed, outer surface with short hairs or papillae and yellow sessile glands, sometimes also with longer branched hairs, inner surface ± glabrous or papillose, especially on the lobes. **Stamens** (4)5(6), exerted for 4–5 mm, filaments purple, 5.5–8.5 mm, anthers oblong, pink or purple, 1.5–3 mm long. **Stigma** capitate, divided into (4)5(6) small lobes, surface glandular. **Fruit** green, maturing red, 2–5 mm wide (in dry specimen), slight depression near apex, outer surface glandular, subtended by the calyx, most of which has broken away, sometimes the calyx remaining more intact; (8)10(12) 1-seeded pyrenes.

**Distribution.** Southern Thailand, Peninsular Malaysia, Sumatra, Borneo, Java, the Philippines, Sulawesi, the Moluccas, New Guinea and possibly the Solomon Islands. In Singapore a native species which has only been recorded twice.

**Ecology.** In the rest of its range grows mainly in disturbed areas such as roadsides, occasionally found in secondary forest or along margins of primary forest; at 15–1500 m altitude.



*Provisional Regional IUCN Conservation Assessment.* In Singapore believed to be extinct. Globally it is Least Concern (Bramley et al., in press).

*Note.* *Callicarpa pentandra* has traditionally been distinguished by its 5-merous flowers; as noted previously (Bramley, 2009), it is not uncommon to find both 4-merous, 5-merous and 6-merous flowers on the same tree. This species was first recorded for Singapore by Ridley (1900), as *Geunsia farinosa* Blume, but has since been ignored by later authors. For notes on the typification of *Callicarpa pentandra* refer to Bramley (2013) and discussion of interspecific variation (see Bramley et al., in press).

*Callicarpa pentandra* is one of the most common species of *Callicarpa* in Southeast Asia. It is, therefore, surprising that it has only been collected twice in Singapore. The first time was by Nathaniel Wallich when he visited the island in 1822 (specimens housed at BM & K-W), and the second time in 1861 by Thomas Anderson (specimen housed at BM). Interestingly it is the only species of Lamiaceae which is not represented by any Singaporean specimens housed at SING. The presence of this species in Singapore is not surprising given its abundance in the wider region and its ecology. Given that it has not been collected in more than 150 years it is believed to be extinct in Singapore.

*Specimens examined.* SINGAPORE: Oct 1822, *Wallich 1836* (BM, K-W); Oct 1861, *Anderson 142* (BM).

***Vitex rotundifolia*** L.f., Suppl. Pl. 294 (1782). – TYPE: Japan, *Thunberg s.n.* (holotype LINN-SM; isotype UPS-THUNB 14619). (Fig. 2)

*Vitex ovata* Thunb. in Murray, Syst. Veg. 57 (1784); Henderson, Malay. Wild Fl. 1: 387 (1959). – *Vitex trifolia* var. *obovata* (Thunb.) Benth., Fl. Austr. 5: 67 (1870), *nom. superfl.* – *Vitex agnus-castus* var. *ovata* (Thunb.) Kuntze, Revis. Gen. Pl. 2: 511 (1891). – *Vitex trifolia* var. *ovata* (Thunb.) Makino, Bot. Mag. (Tokyo) 17: 92 (1903), *nom. superfl.* – TYPE: Japan, *Thunberg s.n.* (holotype UPS-THUNB 14619).

*Vitex trifolia* var. *simplicifolia* Cham., Linnaea 7: 107 (1832); De Kok, Kew Bull. 63: 32 (2008). – TYPE: Philippines, Luzon, Cavite, Dec 1817–Jan 1818, *Chamisso s.n.* (holotype LE).

*Vitex repens* Blanco, Fl. Filip. 513 (1837); Merrill, Species Blancoanae 332 (1918). – TYPE: Philippines, Luzon, Batangas, *Merrill 814* (neotype K [K000182650], designated here by Sengun; isoneotypes L, BM, US, NY).

*Vitex trifolia* var.  $\beta$  *unifoliolata* Schauer in A.P. de Candolle, Prodr. 11: 683 (1847). – TYPE: Japan, *Thunberg s.n.* (lectotype UPS-THUNB 14619, designated here by Sengun).

*Vitex trifolia* var. *repens* Ridl., Fl. Malay Penin. 2: 631 (1923); Munir, J. Adelaide Bot. Gard. 10: 53 (1987). – TYPE: Malaya, Kelantan, *Ridley s.n.* (lectotype K, designated here by Sengun; isoelectotype SING).

*Vitex trifolia* subsp. *littoralis* Steenis, Blumea 8: 516 (1957). – TYPE: [Indonesia] Lesser Sunda Island, Kisar, E of Wonreli, 22 Mar 1939, *Bloembergen 3894* (holotype L; isotype BRI).

Prostrate to small erect shrub, 10–60 cm high, sometimes forming dense mats of several metres diameter, rooting at nodes. **Leaves** 1-foliolate, round to obovate or obovate-spatulate, terminal leaflet 1.4–5.3 × 0.8–3.3 cm, ratio 1.6–1.8, upper surface glabrous or with only few hairs on the veins, lower surface velutinous, hairs whitish, base cuneate, apex mostly rounded, sometimes subacute, margin entire, aromatic when crushed; upper surface green; lower surface pale green to grey-green or silvery; venation 4–7(–9) slightly prominent side veins visible on both surfaces; hairs simple, appressed, with powdery wax; petiole 3–12 mm long, round in cross-section; hairs velutinous, white, appressed, simple. **Inflorescence** terminal and axillary, paniculate, consisting of lateral cymes in dense clusters, 4–12 cm long, angular; hairs dense, appressed, simple. **Bracts** usually reduced relative to leaves; bracteoles triangular to linear, up to 2 mm long, appressed, velutinous, usually caducous. **Calyx** 5-lobed, velutinous, weakly 5-ribbed, slightly accrescent, lobes 2–6 × 3–11 mm; hairs appressed, simple; glands few; flowering calyx 3–4 mm diameter, erect; fruiting calyx 3.5–4.5 mm diameter, erect, covering most of the mature fruit. **Corolla** 5-lobed, covered outside with appressed hairs, base glabrous, purplish blue to white; glands many, white; anterior lip 3.9–7 × 3.3–7.4 mm, spatulate, apex rounded to truncate, margin entire, hairs concentrated at base; lateral lobes 3–4.2 × 2–3 mm, reflexed, apex rounded; posterior lip 2-lobed, lobes 3–3.5 by 3–3.5 mm, reflexed to erect, fused from 10–100% of total length, apex acute; tube 5.3–8.3 mm long, infundibular. **Stamens** with filaments 5.2–8.2 mm long, slightly to strongly didynamous, glabrous except for tuft of erect simple multicellular hairs at base, inserted third to half of tube length from corolla base, clearly exceeding the corolla tube; anthers c. 1.5–2 mm long. **Style** 9.8–14.6 mm long, glabrous; stigma 2-lobed, lobes 6–13 mm long, apex pointed. Ovary 1–1.5 mm diameter, globose, glabrous, apex covered with glands. **Fruit** when fresh unknown; dried fruit globose, 4.4–5.3 × 4.3–5 mm, glabrous, smooth, turning first purplish, then black when mature. **Seeds** 4 (or fewer by abortion) per fruit.

**Distribution.** Widespread from Samoa to the east and north coast of Australia, north to Southern China, Thailand and Japan. The species is apparently absent from most of the central Pacific, but an isolated population occurs in Hawaii. It grows along beaches. In Singapore it is a native species although now believed to be extinct.

**Ecology.** In the rest of its range grows on sandy seashores, coastal dunes and on sandbars along river. Sometimes grows slightly above the high water mark.



**Fig. 2.** *Vitex rotundifolia* L.f. **A.** Habit. **B.** Flowers. (Photos: R.P.J. De Kok from Queensland, Australia)

*Provisional Regional IUCN Conservation Assessment.* In Singapore it is known only from one collection from 1926 and must now be considered to be extinct. Globally considered to be Least Concern (De Kok, 2007).

*Phenology.* Flowering and fruiting from June to January.

*Notes.* Flowers reported to smell like lavender. Otherwise, the whole plant has a pungent smell.

In Singapore this species is only recorded from a single specimen collected by A.W. Hamilton in 1926 which is housed at SING. The collection does not mention any locality details other than 'Singapore'.

This species has often been confused with *Vitex trifolia* L. and is sometimes treated as a subspecies (De Kok, 2007). Singapore Botanic Gardens was a centre of research on this species complex. Its former Director, Henry Ridley, wrote that *Vitex trifolia* 'has 2 forms, one a woody sand-creeper with simple round leaves and the other a bush or small tree, growing inland with trifoliate leaves ... plants of the creeping form which I brought from the sand-hills of the east coast of the Malay Peninsula developed into the bush form when cultivated in the Botanic Gardens, Singapore' (Ridley, 1930). However, Corner, not having ever seen any intermediate form between the two, tested this claim by growing 10 plants in the Singapore Botanic Gardens. In the four years these plants were alive, they never became erect shrubs. In addition, he cited upright *Vitex trifolia* plants that grew on the coastline which did not become creepers; i.e. both plants kept their individual characteristics wherever they grew (Corner, 1939). As a result of an investigation as part of a Ph.D. project (Sengun, in prep.), this taxon is now recognised at the species level.

The coastal vegetation in Singapore has been especially hard hit by development (Turner et al., 1994) and this habitat loss has probably caused the decline of the species in Singapore. Given that it is known only from one collection from 1926 it must be considered nationally extinct.

No type material of Blanco species *Vitex repens* Blanco could be found. The specimen at K from Merrill's Species Blancoanae series has been selected here as the neotype.

Of the various possible syntypes available for lectotypification of Ridley's taxon *Vitex trifolia* var. *repens*, the one collected by himself and housed at K, is selected here as the lectotype.

Of the various syntypes available for lectotypification of the Schauer taxon *Vitex trifolia* var.  $\beta$  *unifoliolata*, the Thunberg specimen housed at the Uppsala Herbarium was selected here as the lectotype, since it was the only one available for detailed study.

*Specimens examined.* SINGAPORE: 19 Sep 1926, Hamilton s.n. (SING).

ACKNOWLEDGEMENTS. This research was supported in 2016 by a Singapore Botanic Gardens Research Fellowship to the first author, which is gratefully acknowledged. The first

author is grateful to Nigel Taylor and David Middleton for all their support. Thanks are due to Bazilah Ibrahim, Serena Lee and many others at the Singapore Botanic Gardens for all their help. We would also like to acknowledge the curators of the BM and K herbaria for access to the specimens used in this study.

## References

- Bramley, G.L.C. (2009). The genus *Callicarpa* (Lamiaceae) on Borneo. *Bot. J. Linn. Soc.* 159: 416–455.
- Bramley, G.L.C. (2013). The genus *Callicarpa* (Lamiaceae) in the Philippines. *Kew Bull.* 68: 369–418.
- Bramley, G.L.C., Forest, F. & De Kok, R.P.J. (2009). Troublesome tropical mints: re-examining generic limits in Lamiaceae subfamily Viticoideae. *Taxon* 58: 500–510.
- Bramley, G.L.C., Bongcheewin, B., Davies, N., Mabberley, D.J., Suddee, S., Walsingham, L.J., Wearn, J.A. & De Kok, R.P.J. (in press). Lamiaceae. In: Van Welzen (ed) *Flora Malesiana*, Series I.
- Chong, K.Y., Tan, H.T.W & Corlett, R.T. (2009). *A Checklist of the Total Vascular Plant Flora of Singapore, Native, Naturalised and Cultivated Species*. Singapore: Raffles Museum of Biodiversity Research, National University of Singapore.
- Corner, E.J.H. (1939). Notes on the systematics and distribution of Malayan phanerogams III. *Gard. Bull. Straits Settlements*. 10: 239–260.
- De Kok, R.P.J. (2007). The genus *Vitex* L. (Labiatae) in New Guinea and the South Pacific Islands. *Kew Bull.* 62: 587–603.
- De Kok, R.P.J. (2008). The genus *Vitex* (Labiatae) in the Flora Malesiana region, excluding New Guinea. *Kew Bull.* 63: 17–40.
- De Kok, R.P.J. (2012). A revision of the genus *Gmelina* L. (Lamiaceae). *Kew Bull.* 67: 293–329.
- De Kok, R.P.J. (2013). The genus *Premna* L. (Lamiaceae) in the Flora Malesiana area. *Kew Bull.* 68: 55–84.
- De Kok, R.P.J., Rusea, G. & Latiff, A. (2009). The genus *Teijsmanniodendron* Koord. (Lamiaceae). *Kew Bull.* 64: 587–625.
- Harley, R.M. & Pastore, J.F.B. (2012). A generic revision and new combinations in the Hyptidinae (Lamiaceae), based on molecular and morphological evidence. *Phytotaxa* 58: 1–55.
- Harley, R.M., Atkins, S., Budantsev, A.L., Cantino, P.D., Conn, B.J., Grayer, R., Harley, M.M., De Kok, R.P.J., Krestovskaja, T., Morales, R., Paton, A.J., Ryding, O. & Upson, T. (2004). Labiatae. In: Kubitzki, K. (ed) *The Families and Genera of Vascular Plants*, Lamiales (except Acanthaceae including Avicenniaceae) VII: 167–275. Berlin: Springer-Verlag.
- Ridley, H.N. (1900). The flora of Singapore. *J. Straits Branch Roy. Asiat. Soc.* 33: 27–196.
- Ridley, H.N. (1930). *The Dispersal of Plants Throughout the World*. Pp. 309–310. London: L. Reeve & Co. Ltd., Ashford.
- Suddee, S., Paton, A. J. & Parnell, A.J.N. (2005). A taxonomic revision of tribe *Ocimeae* Dumort. (Lamiaceae) in continental South East Asia. III. *Ociminae*. *Kew Bull.* 60: 3–75.
- Turner, I.M., Tan, H.T.W, Wee, Y.C., Ali, I., Chew, P.T. & Corlett, R.T. (1994). A study of plant species extinction in Singapore: Lessons for the conservation of tropical biodiversity. *Conservation Biol.* 8: 705–712.
- Wearn, J.A. & Mabberley, D.J. (2011). *Clerodendrum* (Lamiaceae) in Borneo. *Syst. Bot.* 36: 1050–1061.

- Yuan, Y.-W., Mabberley, D.J., Steane, D.A. & Olmstead, R.G. (2010). Further disintegration and redefinition of *Clerodendrum* (Lamiaceae): Implications for the understanding of the evolution of an intriguing breeding strategy. *Taxon* 59: 125–133.

## Notes on the monotypic genus *Hexapora* (Lauraceae), endemic to Peninsular Malaysia

R.P.J. de Kok<sup>1</sup>

<sup>1</sup>Honorary Research Associate, Singapore Botanic Gardens,  
National Parks Board, 1 Cluny Road, Singapore 259569  
dekokrogier@gmail.com

**ABSTRACT.** An account of the genus *Hexapora* (Lauraceae) is presented. It comprises morphological descriptions of the genus and species, a provisional IUCN conservation assessment, ecological information and taxonomic notes. The morphology of the genus is compared to that of a number of possible close relatives, leading to the conclusion that it most likely belongs within the *Beilschmiedia* clade, and is likely closely related to *Sinopora*.

**Keywords.** *Beilschmiedia* clade, Penang, *Sinopora*, taxonomy

### Introduction

The genus *Hexapora* Hook.f. was first described by J.D. Hooker in his *Flora of British India* in August 1886 (Hooker, 1886a). It was based on material sent to him by Charles Curtis, a plant collector and Superintendent of the Gardens and Forests of Penang, in what is now Peninsular Malaysia. The specimens arrived at Kew just before the pages of the *Flora* were sent to the printers, with the result that Hooker only briefly mentioned the genus at the end of the family account. The generic name, according to Hooker, alludes to the pore-like openings at the apices of the cells of the six anthers, and the specific epithet, “*curtisii*”, is in honour of Charles Curtis. However, in November of the same year, Hooker (1886b: t.1547) decided to change the generic name to *Micropora* Hook.f. when he realised that although each flower has six stamens, each stamen has two pores, thus giving a total of 12 pores per flower, rather than six. However, this name change is superfluous and the original name is the nomenclaturally correct one.

The genus is monotypic and endemic to the island of Penang, but in the older literature there has been some confusion about its distribution. Ridley (1893: 341) cited a number of sterile specimens from Pahang as belonging to the genus. These collections were also labelled as *Hexapora* by Henderson in 1925. However, they were later identified as *Beilschmiedia glauca* by Kostermans in 1952, following Gamble (1912: 70–71) who had earlier already placed them in *Beilschmiedia* Nees. Gamble also cited a collection from Perak as belonging to *Hexapora curtisii* Hook.f. but the confusion regarding the locality was caused by the collection labels which are part of a series of King's Collector printed labels that have a standard locality: Perak, Larut. However, in the same hand as the rest of the written part of the label, the locality of Penang is given (see label of *King's Collector* 5215). This mistake was corrected by Ridley (1924: 90).

The classification and circumscription of the various genera in the Lauraceae have always been problematic. This is particularly true for *Hexapora* as only a few specimens are known of which none has fully mature fruits and only one of which has very immature fruits. Recently, molecular data have helped to elucidate relationships in the Lauraceae (Rohwer et al., 2014). In the case of *Hexapora*, given that all known specimens are old, generating molecular data is currently problematic.

Since it was described, *Hexapora* has been compared with a number of other genera, suggesting various possible relationships. It was placed in the Apollonieae by a number of authors (Pax, 1889; Von Dalla Torre & Harms, 1901; Uphof, 1910), together with genera such as *Beilschmiedia* and *Dehaasia* Blume, while other authors (Durand, 1888; Boerlage, 1900) placed it in the Perseeae, together with a large number of other genera of Lauraceae. More recently, Kostermans (1957) placed it in the subtribe *Beilschmiedineae*, comparing it with *Endiandra* R.Br. and *Beilschmiedia*, and Rohwer (1993: 378) put it in the *Beilschmiedia* group of the *Perseeae*, together with *Beilschmiedia*, *Endiandra*, *Brassiiodendron* C.K.Allen and *Potameia* Thouars.

Rohwer (1993) also compared it with the Malagasy endemic *Aspidostemon* Rohwer & Richter. According to him, the massive cushion formed by the stamens and staminodes in the flowers of *Hexapora* is reminiscent of the flowers of *Aspidostemon*. The fruits of *Aspidostemon* are completely enclosed in an accrescent tube (Rohwer, 1993), and according to the *Tree Flora of Peninsular Malaysia*, the fruit in *Hexapora* is seated on the accrescent perianth and stamens (Kochummen, 1989). However, from my own observations on the one specimen of *Hexapora* with very immature fruits, it is clear that the fruit is free and situated above the remains of the perianth and stamens.

Van der Werff (2001) compared *Hexapora* with *Brassiiodendron* as both have six stamens per flower, each with two cells. However, the fruits of *Brassiiodendron* are free on the pedicel, with no remains of the perianth and stamens present, and its stamens have glands, which are not present in *Hexapora*.

In 2008, a new genus of Lauraceae, *Sinopora* J.Li, N.H.Xia & H.W.Li was described from Hong Kong. It shares several characters with *Hexapora*, including some that were previously considered unique to this genus (Li et al., 2008). They include the presence in each flower of six stamens on short filaments, giving the whole complex a cushion-like appearance, and 2-celled anthers which open by pores. At the base of the young fruit in *Sinopora* are the remains of perianth lobes, stamens and staminodes. However, these are lost when the fruits mature and then they become very reminiscent of *Beilschmiedia* fruits.

### **Discussion of the taxonomic position of *Hexapora***

Ever since the discovery of this genus people have wondered where *Hexapora* fits in the classification of the Lauraceae. Its vegetative morphology is not distinctive and, apart from the presence of small terminal buds, which are in fact very common in the family, all of its vegetative characters are shared with almost all other genera of Asian Lauraceae. The main features of its flowers and fruits are shown in Table 1 to allow



comparison with selected other genera in the family.

Unfortunately, only very immature fruit is known for *Hexapora curtisii*. *Anonymous 3158*, housed at Kew, has two young fruits, one still attached to the infructescence and one unattached and in a packet. At the base of both fruits are the remains of broken off free perianth lobes, stamens and staminodes. This is in contrast to what has previously been reported (see Kochummen, 1989; Rohwer, 1993). Most genera to which *Hexapora* has been compared have a distinct type of fruit. In *Beilschmiedia*, *Brassiodendron* and *Endiandra* the mature fruit is on top of the pedicel without any remnants of the perianth or stamens (Van der Werff, 2001). In addition, in some species of *Beilschmiedia*, the apex of the fruit stalk can have a slight circular restriction just below the fruit. This was observed in some of the Bornean species by Nishida (2008: Fig 27K) and in some of the Peninsular Malaysian species by De Kok (in press). This is also found in very young fruit stalks in *Hexapora*.

In the Lauraceae the numbers of stamens and staminodes in a flower are among the main characters used to delimit genera. The androecium in this family is typically organised in four whorls, each composed of three stamens or staminodes. Most genera have a single diagnostic arrangement, but a small number of genera show some variation (Van der Werff, 2001, see also Table 1). It is, therefore, no surprise that all the genera thought to be closely related to *Hexapora* can have six stamens (see Table 1). In addition, the presence or absence of glands at the base of the stamens is also an important feature in these genera. The particular organisation of the stamens of *Hexapora* in a cushion-like structure is one of its most characteristic features and is shared with only a few other genera, most notably *Sinopora* and maybe with some species of *Endiandra*. In the latter, the glands at the base of the stamens can be greatly enlarged and are united, forming a disc that surrounds the androecium and gynoecium (Van der Werff, 2001).

One of the other main characters used in the classification of the Lauraceae is the number of cells per anther, and to a lesser extent the shape of the anthers and their type of opening. As with stamen number, most genera have a constant number of cells per anther, but variation does occur in some (Van der Werff & Richter 1996). All genera in Table 1 have 2-celled anthers, which are either introrse or extrorse. Whether there is really a difference in the shape of the openings is debatable. Both in *Sinopora* and *Hexapora* the openings are reported to be small and round, whereas in the other genera in Table 1 they are more or less oval.

No molecular studies have yet been undertaken on *Hexapora*, although *Sinopora* was included in a study of the *Cryptocarya* group (Rohwer et al., 2014). This genus was well supported as sister to a group of Central American *Beilschmiedia* species in the Bayesian analysis, the ITS analysis and in the combined analysis, but received less than 50% bootstrap support in the parsimony analysis.

*Sinopora* and *Hexapora* are likely to be closely related and they may even be congeneric. Taking these two genera together, their closest relatives are most likely to be either *Beilschmiedia* and/or *Endiandra* in the *Beilschmiedia* clade. This conclusion is mainly based on the possession of similar types of fruit, which is free when mature and in which the fruit stalk has a slight circular restriction at its apex (common in

*Beilschmiedia*) and present in at least *Hexapora*, not yet observed in *Sinapora*. Suggestions of their close relationship are further supported by the numbers of stamens and anther cells in these genera and their geographical distributions.

### Material and Methods

The generic and specific descriptions in this study are based on observations of herbarium specimens from BM, K and SING. In the following descriptions:

- i) all measurements and colour descriptions are from mature material;
- ii) all measurements and statements about the position of the veins relative to the remainder of the leaves are taken from dried material;
- iii) all collections of *Hexapora* seen by the author are cited;
- iv) all synonyms of *Hexapora* are included;
- v) for the provisional IUCN conservation assessment, the extent of occurrence (EOO) and area of occupancy (AOO) were calculated using <http://geocat.kew.org> on 3 December 2015.

### Taxonomic treatment

#### *Hexapora* Hook.f.

Fl. Brit. India 5: 189 (1886); Kosterm., Commun. For. Res. Inst. Bogor 57: 38 (1957); Kosterm., Bibliogr. Laurac. 540 (1964); Kochummen, Tree Fl. Malaya 4: 114 (1989); Rohwer, Fam. Gen. Vasc. Pl. 2: 385 (1993); Van der Werff, Blumea 46: 137 (2001). – TYPE SPECIES: *Hexapora curtisii* Hook.f.

*Micropora* Hook.f., Hooker's Icon. Pl. 16: t. 1547 (1886b), nom. superfl.; Hook.f., Fl. Brit. India 5: 862 (1890); Gamble, J. Asiatic Soc. Bengal. 75: 70–71 (1912); Ridl., Fl. Malay Pen. 3: 90 (1924). – TYPE SPECIES: *Micropora curtisii* Hook.f. (= *Hexapora curtisii* Hook.f.)

Trees. **Terminal buds** not perulate. **Leaves** alternate, somewhat clustered at twig apex, penninerved, not glaucous below. **Inflorescences** formed of panicles (type 3 in Van der Werff (2001)), involucre bracts absent. **Flowers** trimerous, bisexual; perianth tube not distinct; perianth lobes 6, equal, erect at anthesis, shorter than stamens. Stamens 6, in 2 whorls, without glands; filaments slightly longer than anthers; 3rd and 4th rows of androecium consisting of thick staminodes as large as the fertile stamens, together with the stamens forming a massive cushion in the flower; anthers 2-celled, each cell opening by a circular apical pore. Ovary glabrous, narrowing into a short style, stigma minute. **Young fruit** with persistent perianth and stamens/staminodes at the base, mature fruit unknown.

**Distribution.** Only known from the Malaysian island of Penang.

*Notes.* In his discussion of the inflorescence of *Hexapora*, Van der Werff (2001) says that it has a 'type 3' inflorescence which is paniculate and in which the lateral flowers of the ultimate cymes are somewhat alternate rather than strictly opposite. This can be confirmed in this study as the short central axis has cymes coming off at irregular intervals. Most of these cymes are reduced to single flowered ones although occasionally there are also two or three flowered ones (see Fig. 1).

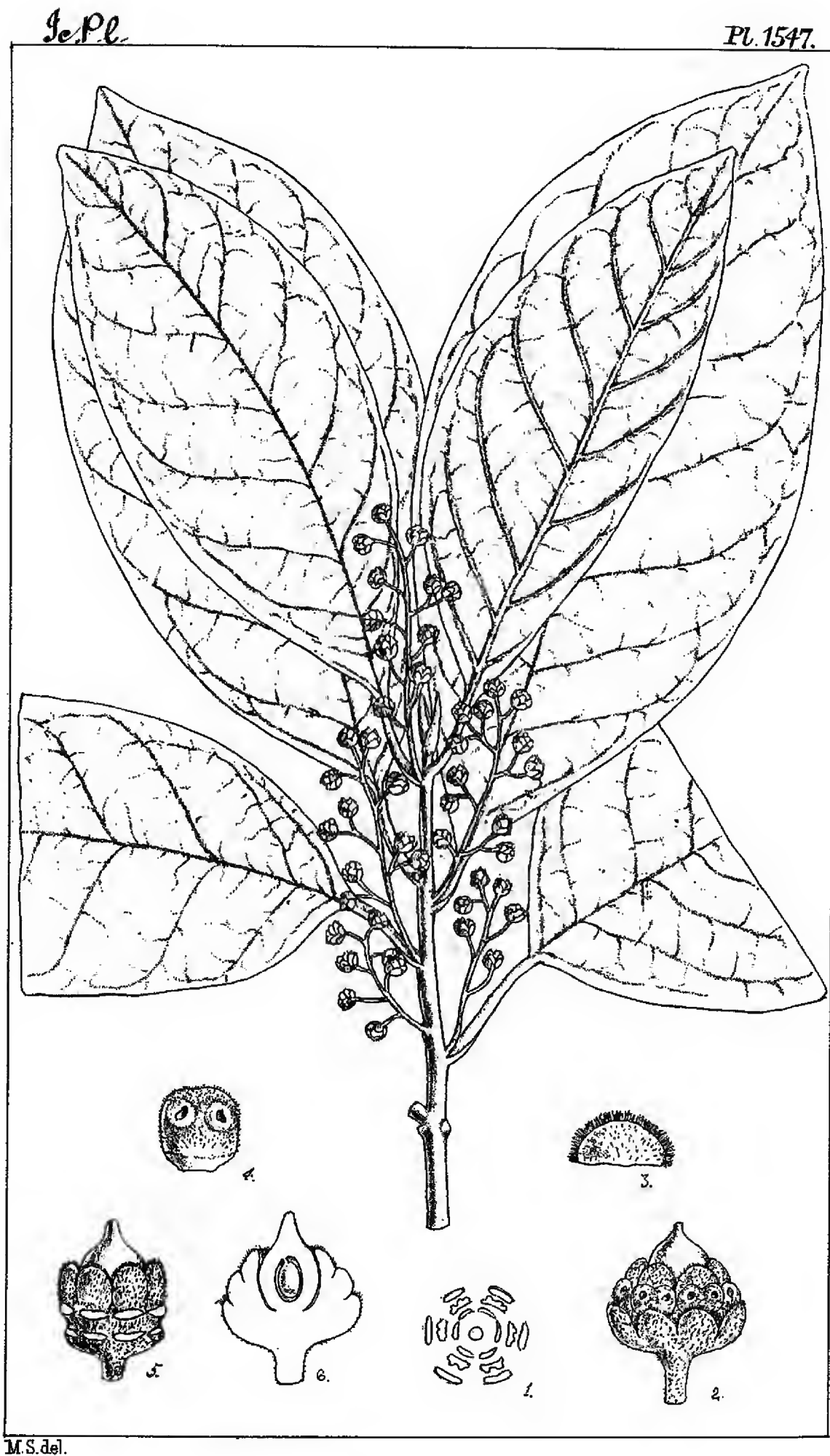
*Hexapora curtisii* Hook.f., Fl. Brit. India 5: 189 (1886); Kosterm., Bibliogr. Laurac. 540 (1964); Kochummen, Tree Fl. Malaya 4: 114 (1989). – *Micropora curtisii* Hook.f., Hooker's Icon. Pl. 16: t. 1547 (1886), nom. superfl.; Hook.f., Fl. Brit. India 5: 862 (1890); Gamble, Asiatic Soc. Bengal. 75: 70–71 (1912); Ridl., Fl. Malay Pen. 3: 90 (1924). – TYPE: Peninsular Malaysia, Penang, close to Chalet, December 1885, *Curtis* 524 (holotype K [K000778553]). (Fig. 1)

Trees 12–18 m tall, dbh up to 40 cm. *Twigs* slender, 1.8–2.3 mm diameter, velutinous to densely hairy when young, smooth; terminal buds lanceolate, 2.9–4 mm long, velutinous. *Leaves* alternate, elliptic, 6–13 × 3–6 cm, apex acute to rounded, base cuneate, slightly asymmetric, margins straight to slightly recurved when dried, blades thinly leathery, dark green; secondary veins 7–9 pairs, curved towards the margins and merging with the tertiary venation; tertiary veins reticulate; upper surface of blades glabrous apart from a densely hairy main vein, main vein sunken at base, secondary veins raised, tertiary venation distinct; lower surface of blades glabrous, main vein and secondary veins raised, tertiary venation distinct. Petioles 9.5–13 mm long, half terete, slightly swollen at base, velutinous when young, densely hairy when older. *Inflorescences* 12–31 mm long, not enclosed by bracts, densely hairy; bracteoles lanceolate, 0.5–1.4 mm long, with acute apex, caducous. *Flowers* pale yellow; perianth lobes 6, equal, orbicular, 0.75–0.9 × 0.75–0.9 mm, apex rounded, sparsely to densely hairy, margin not ciliate. Stamens 6, in 2 rows of 3, orbicular, 1 × 0.8 mm, apex rounded to emarginate, without glands. Ovary 1–1.2 mm diam., ovoid, glabrous; style c. 0.5 mm long. *Fruit* (only immature fruit known) globose, 3.2–3.4 × 2.8–3.2 mm, smooth, glabrous, free, with remains of perianth, stamens and staminodes present below the base. Fruit stalk not to slightly swollen, circular restriction at apex of stalk present.

*Distribution.* Endemic to Penang Island, Malaysia.

*Ecology.* Growing in open forest at 240–830 m altitude. Flowering from March to December; fruiting time unknown.

*IUCN Conservation Assessment.* Data Deficient (DD). This species has been collected 10 times, all between 1883 and 1901, on the hills of the northern part of the island of Penang. A fieldtrip in May 2015 failed to locate the species. The Extent of Occurrence (EOO) suggests a status of Critically Endangered, while the Area of Occupancy (AOO) gives an assessment of Endangered. However, this part of Penang Island still has much



*Micropora curtisii*, Hk.f.

**Fig. 1.** Original plate of Hooker (November 1886b) of *Micropora curtisii* Hook.f. (= *Hexapora curtisii* Hook.f.). 1 = floral diagram; 2 = flower; 3 = apex of perianth lobes; 4 = anther; 5 = ovary with staminodes; 6 = longitudinal section of flower. Reproduced with the kind permission of the Director and the Board of Trustees, Royal Botanic Gardens, Kew.

**Table 1.** Morphological comparison between *Hexapora* and other genera of Lauraceae with which it is usually compared.

Genus	Stamen number	Anther opening	Stamens short and thick	Glands on stamens	Fruit	Perianth persistent	Distribution
<i>Anaueria</i>	6	Valves, near apex	Outer whorl short	Absent	Free or enclosed at base	Yes	South America
<i>Aspidostemon</i>	3 or 6	Apical valves	Yes, only the 3th whorl	Present	Completely enclosed	Yes	Madagascar
<i>Beilschmiedia</i>	6 or 9	Valves	No	Present	Free	No	Pan tropical
<i>Brassiodes-dron</i>	4, 5 or 6	Valves	Yes	Present	Free	No	Australia to New Guinea
<i>Endiandra</i>	2 or 3	Valves	Yes	Usually present	Free	No	Asia
<i>Hexapora</i>	6	Pores at apex	Yes	Absent	Free	Yes	Peninsular Malaysia
<i>Sinopora</i>	6	Pores at apex	Yes	Absent	Free	Yes, when young	China

of its original forest surviving in good condition and it is well protected. Given the lack of recent data concerning this species and its population status, it is listed here as Data deficient, until more data becomes available.

*Notes.* Several specimens collected by Curtis are present at K, SING and one at BM; most have the same number (or give no number). However, these numbers were added later and are not collection numbers (Van Steenis-Kruseman, 1950). Only one specimen with the number 524 has the collection locality and date mentioned in the original description, and this sheet [K000778553] is accepted here as the holotype.

*Additional specimens examined.* PENINSULAR MALAYSIA: **Penang:** ‘Perak, Larut’, [Penang]: Nov 1883, *King’s Collector 5215* (K [4 sheets]); ‘Perak’ [Penang in hand written notes on label], *Cantley’s Collector s.n.* (SING [2 sheets]); s.d., *Anonymous 3158* (K); Jul 1890, *Curtis s.n.* (BM); 1885, *Curtis 524* (K [2 sheets]); West Hill, Sep 1887, *Curtis 1214* (K); ibidem, Sep 1887, *Cantley’s Collector 1214* (SING); Government Hill, Mar 1890, *Curtis 1214* (SING [2 sheets]); ibidem, Oct 1892, *Curtis 524* (SING [3 sheets]); ibidem, 1901, *Curtis 524* (K).

**ACKNOWLEDGEMENTS.** The author is grateful to the curators of BM, K, KEP and SING herbaria for access to the specimens used in the present study. I am very grateful to Helen Hopkins for checking my English; to Julia Buckley for helping with the Hooker plate; the Forest Research Institute Malaysia for providing a one month Visiting Research Fellowship as part of the *Flora of Peninsular Malaysia* Project which enabled me to study the material at KEP

and to visit the old collection sites on Penang Island; Chew Ming Yee from FRIM for all her help in the field in Penang in 2015 and for her keen plant-spotting skills; and Singapore Botanic Gardens for providing a one-month Research Fellowship in 2015 and a further three-month grant in 2016 which enabled me to study their material at SING.

### References

- Boerlage, J.G. (1900). *Handleiding tot de Kennis der Flora Nederlansch Indië* vol. 3. Leiden: Brill.
- De Kok, R.P.J. (in press). A revision of *Beilschmiedia* Nees (Lauraceae) of Peninsular Malaysia. *Blumea*.
- Durand, T. (1888). *Index Generum Phanerogamorum*. Bruxellis: Sumptibus Auctoris.
- Gamble, J.S. (1912). Materials for a Flora of The Malayan Peninsula no. 22. *J. Asiatic Soc. Bengal* 75: 1–204.
- Hooker, J.D. (1886a). Laurineae. In: Hooker, J.D. (ed) *The Flora of British India* 5: 116–188. London: L. Reeve & Co.
- Hooker, J.D. (1886b). *Micropora curtisii* Hook.f. *Hooker's Icon. Pl.* 16: t. 1547.
- Kochummen, K.M. (1989). Lauraceae. In: Ng, F.S.P. (ed) *Tree Flora of Malaya* 4: 98–178. Malaysia. Longman.
- Kostermans, A.J.G.H. (1957). Lauraceae. *Commun. Forest Res. Inst. Bogor* 57: 1–64.
- Li, J., Xia, N.H. & Li, X.W. (2008). *Sinopora*, a new genus of Lauraceae from South China. *Novon* 18: 199–201.
- Nishida, S. (2008). Taxonomic revision of *Beilschmiedia* (Lauraceae) in Borneo. *Blumea* 53: 345–383.
- Pax, F.A. (1889). Lauraceae. In: Engler, A. & Prantl, K. (eds) *Die Natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten, insbesondere den Nutzpflanzen, unter Mitwirkung zahlreicher hervorragender Fachgelehrten begründet von A. Engler und K. Prantl, fortgesetzt von A. Engler*. 3(2): 106–126.
- Ridley, H.N. (1893). On the flora of the eastern coast of the Malay Peninsula. *Trans. Linn. Soc. London, Bot.* 2nd ser. 3: 267–408.
- Ridley, H.N. (1924). *The flora of the Malay Peninsula* vol. 3. London: L. Reeve & Co.
- Rohwer, J.G. (1993). Lauraceae. In: Kubitzki, K., Rohwer, J.G. & Bittrich, V. (ed) *The Families and Genera of Vascular Plants* vol. 2. Pp 366–391. Berlin: Springer-Verlag.
- Rohwer, J.G., De Moraes, P.L.R., Rudolph, B. & Van der Werff, H. (2014). A phylogenetic analysis of the *Cryptocarya* group (Lauraceae), and relationships of *Dahlgrenodendron*, *Sinopora*, *Triadodaphne*, and *Yasunia*. *Phytotaxa* 158: 111–132.
- Uphof, J.C.T. (1910). *Die Pflanzengattungen*. Leipzig: Weigel.
- Van der Werff, H. & Richter, H.G. (1996). Toward an improved classification of Lauraceae. *Ann. Missouri Bot. Gard.* 83: 409–418.
- Van der Werff, H. (2001). An annotated key to the genera of Lauraceae in the Flora Malesiana Region. *Blumea* 46: 125–140.
- Van Steenis-Kruseman, M.J. (1950). Malaysian plant collectors and collections: Being a cyclopaedia of botanical exploration in Malaysia and a guide to the concerned literature up to the year 1950. *Flora Malesiana*, Series I, 1: 5–605. Djakarta. Noordhoff-Kolff.
- Von Dalla Torre, K.W. & Harms, H.A.T. (1901). *Micropora. Genera Siphonogamarum ad systema Englerianum conscripta*. P. 178. Lipsiae: Engelmann.

## *Hanguana fraseriana* (Hanguanaceae), a new species from Peninsular Malaysia

J. Leong-Škorničková<sup>1</sup> & R. Kiew<sup>2</sup>

<sup>1</sup>Herbarium, Singapore Botanic Gardens, National Parks Board,  
1 Cluny Road, 259569 Singapore  
jana\_skornickova@nparks.gov.sg

<sup>2</sup>Forest Research Institute Malaysia  
Kepong 52109, Selangor, Malaysia  
ruth@frim.gov.my

**ABSTRACT.** *Hanguana fraseriana*, a new species from Peninsular Malaysia, is described and illustrated here.

**Keywords.** Fraser's Hill, *Hanguana exultans*, *H. stenopoda*, *H. triangulata*, Pahang

### Introduction

Field-based research on *Hanguana* Blume in recent years has led to the realisation that a genus that was thought to be monospecific is actually very diverse, with an estimate of at least 50 species in SE Asia (Leong-Škorničková & Boyce, 2015). Based on the study of herbarium material in several herbaria, we estimate that more than 20 species will be recognised in Peninsular Malaysia. Indeed, several new species have been described recently from Peninsular Malaysia (Siti Nurfazilah et al., 2010, 2011) and Singapore (Niissalo et al., 2014; Leong-Škorničková & Boyce, 2015). As previously mentioned (Leong-Škorničková & Boyce, 2015), the best characters for reliable species delimitation and descriptions of new species are from living material of mature fruiting female specimens. Species recognition is possible, but more difficult, from herbarium material if there are mature fruit but becomes much more difficult or impossible if the herbarium material only has flowers (male or female) and no mature fruit.

Here we describe a new species from Fraser's Hill, Peninsular Malaysia. This species was previously listed in the *Seed Plant Flora of Fraser's Hill* (Kiew, 1998) as *Hanguana malayana*, following the then-accepted monospecific treatment of the genus by Backer (1951). Examination of 857 herbarium sheets of *Hanguana* in E, K, KEP, L, P and SING (Thiers, continuously updated) revealed only a single previous record of this species from Fraser's Hill, collected by E.J.H. Corner in 1937, although without exact locality.

An introduction to the genus was given in a recent work by Leong-Škorničková & Boyce (2015) and is, therefore, not repeated here. The description follows the format outlined in Leong-Škorničková & Boyce (2015). An introduction to the vegetation of Fraser's Hill has been given by Kiew (1998).

***Hanguana fraseriana* Škorničk. & Kiew, sp. nov.**

Similar to *Hanguana triangulata* Škorničk. & Boyce, but differs in less prominently corrugated leaves, overall longer infructescence branches (median branches of lower partial infructescences 16–21 cm versus 6–8 cm in *H. triangulata*), by stigma shape (stigma lobes ovate, connate at base with round apices forming a trefoil shape versus stigma lobes trullate, connate at base with sharply acute apices forming a sharply equilateral triangular structure in *H. triangulata*) and the seed appendage (broadly triangular appendage versus a blunt appendage composed of two sub-lobes in *H. triangulata*). – TYPE: Peninsular Malaysia, Pahang, Fraser's Hill, along Bishop Trail, c. 1200 m asl, 11 September 2014, R. Kiew & J. Leong-Škorničková FRI89123 (holotype KEP (mounted on 5 sheets and inclusive of fruit in spirit); isotypes K, SING (both also mounted on 5 sheets and inclusive of fruit in spirit)). (Fig. 1, 2)

Herbaceous, dioecious mesophyte to c. 1.4 m tall; stem terete, to 3 cm in diam., basally semi-ascending, with age becoming leafless and 'woody' (up to 40 cm in length), terminally ascending with crown of up to 25 leaves; stolons absent. **Leaves** to 145 cm long, spreading and arching; **bases** imbricate, margins hyaline (young leaves), turning erose-marcescent with age; **pseudopetiole** 40–55 cm long, 8–10 mm wide, accounting for 1/3–1/2 of entire leaf length, canaliculate with sharp margins, sparsely softly flocculose; **leaf blade** 60–90 × 12–15.4 cm, narrowly elliptic, base attenuate, tip long narrowly attenuate, leathery, adaxially dark green, shiny, glabrous, abaxially matte mid-green, covered with silky flocculose hair (visible in young leaves, falling off with age); **midrib** weakly impressed, almost of same colour as rest of lamina, glabrous adaxially, round-raised, mid green, sparsely flocculose abaxially. Female and male inflorescences not observed, although, based on observations of infructescence architecture, almost certainly erect at anthesis. **Female flowers** scattered, always solitary, sessile, each with an associated minute bracteole; **perianth** composed of 6 tepals in two whorls tightly clasping ovary/fruit in fresh material, all tepals with prominent bulbous thickening at base (more prominent in outer whorl), light green, margin 0.4–0.5 mm wide, hyaline translucent white; **outer tepals** broadly ovate, c. 2 mm long, 3.5–4 mm broad, free to base, sparsely arachnoid; **inner tepals** broadly ovate, c. 3.5 mm long, c. 4.5 mm broad, free to base, almost glabrous (occasionally sparsely arachnoid); **staminodes** 6, in two whorls, cream-white, triangular to narrowly triangular, **outer staminodes** minute, triangular, c. 0.6 mm long, 0.5 mm broad at base, inner staminodes larger, c. 1.5 mm long, 0.7 mm at base, each with basal staminodial scale, c. 0.6 mm long, and c. 1 mm broad, irregularly rectangular with blunt corners, brown with translucent margin. **Stigma** 3-lobed, each lobe c. 1–1.2 mm long (fruiting material), lobes ovate with round apices, basally connate (rarely imperfectly so) forming trefoil-like structure (c. 2 mm in diam. in fruiting material), raised, matte dark brown in late fruiting stage. **Infructescence** erect, comprising of up to 8 partial, whorled, alternate-secund, thyrsoid infructescences plus a terminal spike; partial infructescences spreading, almost perpendicular to rachis (very weakly ascending); peduncle and rachis together up to 110 cm tall, mid-green when fresh, conspicuously grey-flocculose, visible portion of peduncle up to c. 40 cm long; sterile bracts two per





**Fig. 1.** *Hanguana fraseriana* Škorničk. & Kiew. **A.** Habit. **B.** Close-up of an infructescence. From type *FRI89123*. (Photos: J. Leong-Škorníčková)

peduncle, foliaceous, ovate with a basal claw, persistent, lower bract 70 (incl. claw) × 13.2 (at widest) cm, upper bract 43 (incl. claw) × 10.3 cm; bract subtending the lowest partial infructescence similar to sterile bracts 27 × 6 cm, bracts at upper infructescences diminishing in size distally along the infructescence into small narrowly triangular bracts, and fully reduced in uppermost partial infructescences; *partial infructescences* each comprising of up to 10 branches at basal levels (less towards the apex of the inflorescence); *branches* simple (with no further branching), arising simultaneously from the axil of the subtending bract, lateral branches progressively shorter in length (outermost lateral branches 2/3–1/2 of the median branch); *median branch* 16–21 cm long (in lower infructescences), c. 3 mm in diam. **Fruit** cream to pale yellow externally (almost ripe), pulp 1–2 mm thick, hard, cream-white, globose or almost so (depending on number of seeds ripening), 7–10 mm diam., ripening from bright green to cream to pale yellow; *seeds* one to three per fruit (almost ripe), c. 6 × 5 mm, pale brown (expected to darken when fully ripe), broadly boat-shaped to bowl-shaped, deeply excavated, with a broadly triangular appendage with more or less blunt apex positioned on the distal part of the rim, cavity filled with placental tissue.

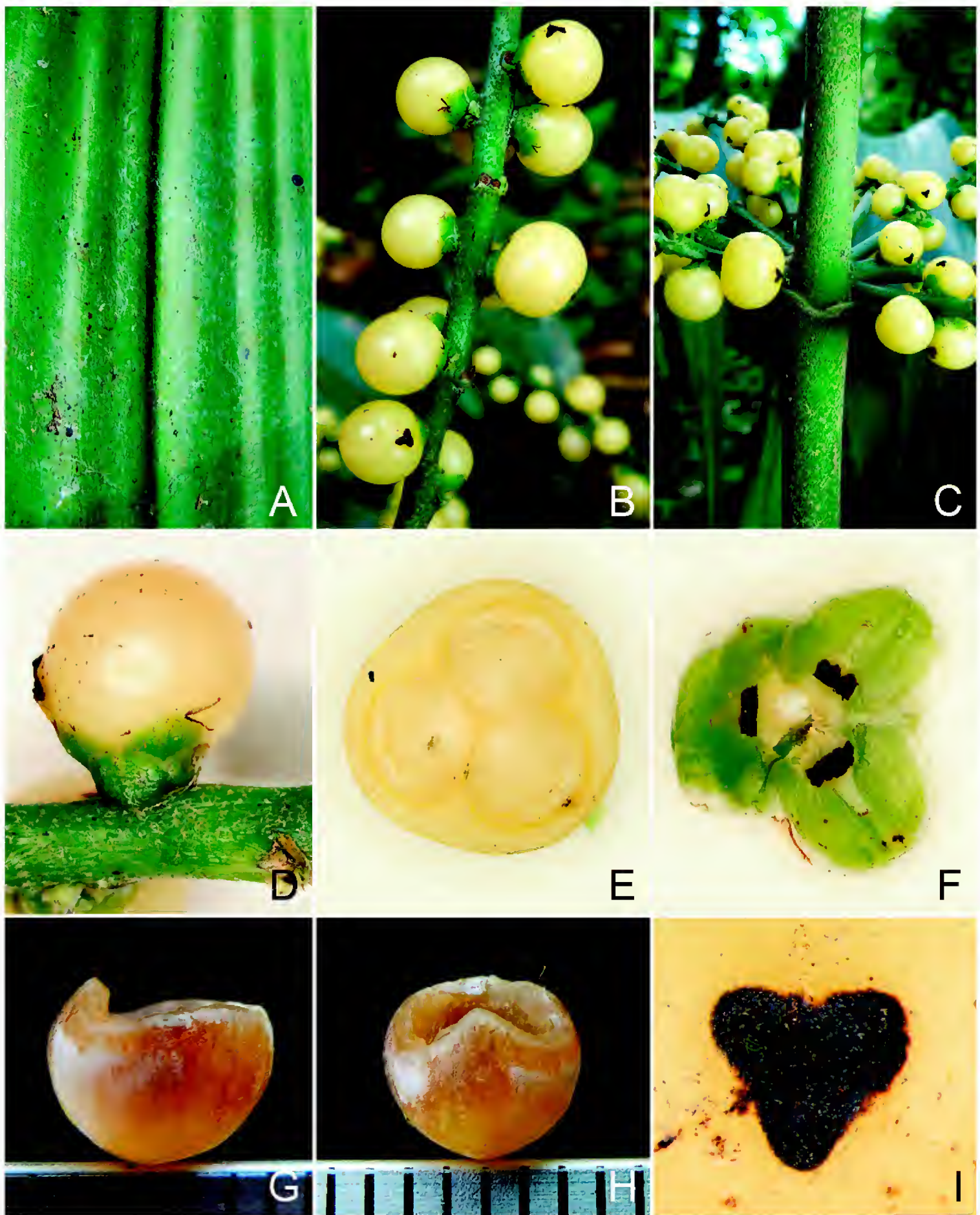
*Eponymy.* Named for James Louis Fraser, who in the 1890s lived and died at the place, Fraser's Hill, that later took his name.

*Distribution and Ecology.* So far known only from the Fraser's Hill, Pahang, Peninsular Malaysia. This species grows on steep slopes in the undergrowth of broadleaved lower montane forest, at c. 1200 m altitude.

*Preliminary IUCN conservation assessment.* This species is so far known only from the Fraser's Hill in certain parts of Bishop and Maxwell's trails, where the total number of the adult individuals does not exceed 30. It is likely that this species is also distributed in the surrounding hills, but until better evidence surfaces, we propose, in lines with IUCN recommendations (IUCN, 2012), to treat *Hanguana fraseriana* as Data Deficient.

*Additional specimens examined.* PENINSULAR MALAYSIA: **Pahang:** Fraser's Hill, 12 Aug 1937, Corner; E.J.H. s.n. (SING).

*Notes.* So far seven species of *Hanguana* have been described from Peninsular Malaysia. Of these only two lowland species, *Hanguana exultans* Siti Nurfaizilah et al. and *H. stenopoda* Siti Nurfaizilah et al., have fruits creamy white at maturity and therefore could potentially be mistaken for this species. *Hanguana exultans* can be distinguished by the partial infructescences with fewer and much shorter branches (up to 7 branches per partial infructescence, with median branches c. 9 cm long), which are sharply ascending in the fruiting stage, and a stigma comprised of three free lobes. *Hanguana stenopoda*, although with similar stigma structure, has a dark brown-red peduncle and rachis in the fresh state, fewer and shorter branches (up to 4 branches per partial infructescence, with median branches c. 5–7 cm long) and female flowers are mainly arranged in groups of two or three.



**Fig. 2.** *Hanguana fraseriana* Škorničk. & Kiew. **A.** Close up of leaf indumentum (abaxial side). **B.** Detail of fruits. **C.** Detail of rachis with a dense flocculose indumentum. **D.** Side view of a fruit, showing tepals and obliquely positioned stigma. **E.** Cross-section of a fruit with three seeds. **F.** Detail of inner tepals, staminodes and staminodial scales. **G.** Young seed (lateral view; scale in mm). **H.** Young seed (front view; scale in mm). From type *FRI89123*. (Photos: J. Leong-Škorničková)

ACKNOWLEDGEMENTS. We thank the curators of KEP and SING for allowing us to examine the specimens in their care. The herbaria E, K, L and P are thanked for their extensive on-line resources, which allowed us to review *Hanguana* sheets online. The research of JL-Š is supported by the National Parks Board Singapore, the research of RK is part of the *Flora of Peninsular Malaysia* project (no. 01-04-01-0000 Khas) funded by the Ministry of Science, Technology and Innovation. We thank the Fraser's Hill Development Board for permission to carry out research at Fraser's Hill.

### References

- Backer, C.A. (1951). *Hanguana*. In: Van Steenis, C.G.G.J. (ed) *Flora Malesiana*, ser. 1, 4(3): 248–250.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. Gland, Switzerland and Cambridge, UK: IUCN.
- Kiew, R. (1998). *The Seed Plant Flora of Fraser's Hill, Peninsular Malaysia, With Special Reference to Its Conservation Status*. Kuala Lumpur: Forest Research Institute Malaysia
- Leong-Škorničková, J. & Boyce, P.C. (2015). *Hanguana* in Singapore demystified: an overview with descriptions of three new species and a new record. *Gard. Bull. Singapore* 67(1): 1–28.
- Niissalo, M., Wijedasa, L., Boyce, P.C. & Leong-Škorničková, J. (2014). *Hanguana neglecta* (Hanguanaceae): a new plant species from a heavily collected and visited reserve in Singapore. *Phytotaxa* 188(1): 14–20.
- Siti Nurfazilah, A.R., Mohd Fahmi, A.B., Ahmad Sofiman, O. & Boyce, P.C. (2010). Studies on *Hanguana* (Commelinales-Hanguanaceae) for Sunda II: Five new forest species, a new species record from Peninsular Malaysia, and a redefinition of the taxonomic limits of *Hanguana malayana*. *Willdenowia* 40: 205–219.
- Siti Nurfazilah, A.R., Ahmad Sofiman, O. & Boyce, P.C. (2011). Studies on *Hanguana* (Commelinales-Hanguanaceae) for Sunda I: *Hanguana bakoensis*, a new forest species from Sarawak, Malaysian Borneo, and notes on critical morphologies for elucidating *Hanguana* taxonomy. *Acta Phytotax. Geobot.* 61(3): 139–143.
- Thiers, B. (continuously updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/> (accessed on 12 Jun. 2016).

## Nomenclatural updates and new records in Peninsular Malaysian Pentaphylacaceae

T.L. Yao

Forest Research Institute Malaysia, Kepong 52109,  
Selangor, Malaysia  
yaotzeleong.frim@l govuc.gov.my

**ABSTRACT.** Four nomenclatural updates, viz. *Ternstroemia coriacea*, *T. palembangensis*, *T. penangiana* and *T. wallichiana*, and two new records *T. patens* and *Eurya glabra* in Peninsular Malaysia are presented.

**Keywords.** *Eurya*, lectotypification, *Ternstroemia*

### Introduction

In Peninsular Malaysia, Pentaphylacaceae Engl., nom. cons. is represented by *Anneslea* Wall., *Adinandra* Jack, *Eurya* Thunb., *Pentaphylax* Gardner & Champ. and *Ternstroemia* Mutis ex L.f. These genera were previously variously included in Ternstroemiaceae (Ridley, 1922), Theaceae (Keng, 1978; Corner, 1997) and Pentaphylacaceae *sensu stricto* (Van Steenis, 1955; Whitmore, 1973; Yao, 2010). Phylogenetic research by Anderberg et al. (2002) suggested re-circumscription of these families. Weitzman et al. (2004) adopted an expanded Ternstroemiaceae concept, which included three tribes (genera that occur in Peninsular Malaysia are listed in parentheses): (i) Pentaphylaceae P.F.Stevens & A.L.Weitzman (*Pentaphylax*), (ii) Ternstroemieae DC. (*Anneslea* and *Ternstroemia*) and (iii) Freziereae DC. (*Adinandra* and *Eurya*). This circumscription is now widely accepted and referred to as Pentaphylacaceae (Stevens, 2001 onwards; Culham, 2007; Mabberley, 2008).

A taxonomic revision of Pentaphylacaceae for the *Flora of Peninsular Malaysia* is in progress. In this precursory paper, confusion over the application of names for plants that occur both within and outside Peninsular Malaysia is addressed. Images of type specimens are more accessible now than ever before and their study has enabled the recognition and clarification of four misapplied names in previous Floras (Dyer, 1874; King, 1890; Ridley, 1922; Keng, 1978). These are discussed below under Nomenclatural Updates. In addition, as additional herbarium materials became available, especially from previously under-collected areas, two new records for Peninsular Malaysia, one each from *Eurya* and *Ternstroemia*, were discovered. These are discussed below under New Records. The distribution of these taxa is based on specimens and literature. The key characters of all taxa treated below are provided. A selection of Peninsular Thailand, Peninsular Malaysia and Singapore specimens deposited in BO, K, KEP, KLU, L, SING and UKMB (Thiers, continuously updated) are listed.

### Nomenclatural updates

**1. *Ternstroemia penangiana*** Choisy, Mém. Soc. Phys. Genève 14: 108 (1855); Dyer in Hook.f., Fl. Brit. India 1: 281 (1874), pro parte; King, J. Asiat. Soc. Bengal 59(2): 193 (1890), pro parte. – *Fagraea dubia* Wall., Numer. List 4456 (1830), nom. nud. – TYPE: Malaysia, Penang, 1822, *Wallich 4456* (lectotype G [G00354922], designated here; isolectotypes G [G00354944] pro parte, K [K000674013]).

*Garcinia acuminata* Wall., Numer. List 4871A (1830), nom. nud. (fide Hooker J. Linn. Soc. 14: 486).

*Ternstroemia bancana* Miq., Fl. Ind. Bat. Suppl.: 477 (1861); Ridley, Fl. Malay Pen. 1: 197 (1922); Keng, Tr. Fl. Malaya 3: 293 (1978). – *Adinandra miquelii* King, J. Asiat. Soc. Bengal 59(2): 192 (1890), nom. illeg. – TYPE: Indonesia, Bangka, Plangas, *Teijsmann 3165* (lectotype U [U1742026], designated here; isolectotype BO [BO-1607547]), **synon. nov.**

*Distribution.* Malaysia (Perak, Selangor, Melaka (Tanjung Tuan [Cape Rachado]), Pahang, Johor); Singapore; Sumatra (Bangka-Belitung) and Borneo.

*Ecology.* From lowlands to c. 600 m elevation, by seashore on clay, high heath forest, low undulating country over sandy soil, damp sandy plateau (Gunung Panti, Johor) and may survive burnt secondary forest. Locally common to frequent.

*Selected specimens.* PENINSULAR MALAYSIA: **Perak:** Manjung, Bruas, Jun 1900, *Curtis 3442* (SING0073934); ibidem, Mar 1896, *Ridley 7970* (SING0073940); Lumut, Feb 1896, *Ridley s.n.* (SING0074044); Simpiti, 1899, *Ridley 10256* (SING0074054); Pasir Panjang, 12 Apr 1937, *Symington FMS43580* (KEP219633); Tanjung Hantu, 13 Mar 1940, *Landon FMS34818* (KEP111785); ibidem, 18 Oct 1957, *Wyatt-Smith KEP78571* (KEP111771, SING0073923); Segari Melintang F.R., 22 Jun 1964, *Kochummen KEP99920* (KEP111791, SING0073933). **Selangor:** Hulu Selangor, Batang Kali F.R., 16 Apr 1940, *Symington FMS50878* (KEP111787); Gading F.R., 20 Jul 1969, *Loh FRI13391* (KEP111767). **Melaka:** Alor Gajah, Cape Rachado F.R., 29 Jan 1967, *Ng FRI1890* (KEP111789, SING0074109), *FRI1891* (KEP111780, SING0074095). **Pahang:** Pontian, Ulu Pontian, 7 Jun 1929, *Mahamud 14967* (SING0074041); Rompin, Menchali F.R., 10 Feb 1983, *Ng FRI27393* (KEP91613); ibidem, 2 Sep 1966, *Rahim KEP98922* (KEP111773, SING0073927); ibidem, 3 May 1982, *Vethevelu FRI29662* (KEP219634, SING0073932); ibidem, 19 Apr 1959, *Wyatt-Smith KEP79180* (KEP111790, SING0073943); Ulu Sg. Anak Endau, 5 Apr 1968, *Cockburn FRI8140* (KEP111757, SING0074114); Rompin River, Leban Chondong, Jul 1917, *Evans 13243* (SING0073921, SING0073931). **Johor:** Johor Bahru, G. Pulau, Dec 1904, *Ridley 12181* (SING0073929); Gn. Panti, 2 Mar 1968, *Cockburn FRI7759* (KEP111772, SING0074099); ibidem, 13 Oct 1935, *Corner SFN29973* (KEP111755, SING0073926); ibidem, Dec 1892, *Ridley s.n.* (SING0073928); Gn. Panti West, 22 Jan 1970, *Everett FRI13824* (KEP111784, SING0074541); ibidem, 25 Jun 1967, *Heaslett 6* (SING0073925); Kota Tinggi, 5 Sep 1965, *Ng KEP118191* (KEP111786, SING0073920); Telok Balau, 4 Sep 1965, *Ng KEP118175* (KEP219636); Ulu Sebol F.R., 7 Feb 1980, *Mat Asri FRI25588* (KEP111788); Mersing,

Endau, Kpg. Hubong, 22 Jul 1959, *Kadim & Mohd Noor KN424* (SING0073937); Gn. Janing, 23 Oct 1985, *Wong FRI30915* (KEP219635); Lenggong F.R., 28 Aug 1997, *Teo & Tetu KL4736* (KEP111793); Pulau, 25 Apr 1922, *Mohd Nur & Kiah 7812* (SING0073930); Segamat, Kuala Palong F.R., 31 May 1970, *Everett FRI14259* (KEP111758, SING0074104); Segamat W.L.R., 2 Jun 1970, *Loh FRI17132* (KEP111770, SING0074100, SING0074111); Tanah Runto, 14 Feb 1890, *Goodenough 1950* (SING0073924).

SINGAPORE: s.l., *Cantley 464* (SING0026364); Bkt. Timah, 19 Jan 1938, *Kiah SFN 34666* (SING0026354); ibidem, 1893, *Ridley 5096* (SING0026360); ibidem, 1894, *Ridley 6554* (SING0026363); Changi, 1889, *Ridley 2028* (SING0026359); Seletar, 16 Oct 1890, *Goodenough 180* (SING0026367); ibidem, *Ridley 1802* (BM); ibidem, 1890, *Ridley 1948* (SING0026362); Sg. Murai, 1892, *Ridley 3986* (SING0026355), *s.n.* (SING0026356), 1893, *s.n.* (SING0026357).

*Notes.* This species was better known as *Ternstroemia bancana* in the Malay Peninsula but is conspecific with the earlier *T. penangiana*. This name, however, was also mistakenly widely applied for *Ternstroemia coriacea* (see below). *Ternstroemia penangiana* is easily recognised by the greyish white, angular young twigs, smooth, thick leathery lamina (9.5–16 × 4.3–7.5 cm) that usually dries reddish grey-brown, ellipsoid fruits on stout pedicel (to 1.8 cm long, 3 mm thick), and a smooth to irregularly ribbed calyx cup clasping the fruit base.

There are two duplicates of *Wallich 4456* deposited in Geneva. G00354922 consists of twigs, leaves, flowers, fruit fragments and has Choisy's handwriting on the sheet. This specimen is designated here as the lectotype. G00354944 is probably a mixed collection with *Ternstroemia penangiana* leaves and twigs and a detached fruit with an atypical warty and thickened calyx cup. *Ternstroemia penangiana* as treated by Dyer (1874) and King (1890) consists of two entities, namely the type, *Wallich 4456*, and material of *Erythrochiton wallichianum* Griff. (see below), which was described from Burma. *Erythrochiton wallichianum* Griff. is also known under the combination *Ternstroemia wallichiana* (Griff.) Engler. King (1890) rightly pointed out these two might not be conspecific. Dyer (1874) and King (1890) mentioned Java as part of the distribution. I couldn't find any Javanese specimens belonging to this species and the true identity of Javanese specimens determined as *Ternstroemia penangiana* needs further study.

Miquel (1861) gave Plangas as the type locality of *Ternstroemia bancana* and *Teijsmann 3165* is the only collection which would have been available to Miquel from the locality mentioned. The specimen in Utrecht is hence selected as lectotype.

**2. *Ternstroemia coriacea*** Scheff., Tijdschr. Nederl. Ind. 31: 352 (1870); King, J. Asiat. Soc. Bengal 59(2): 194 (1890). – TYPE: Indonesia, Bangka, Batoe-Balai, *Teysmann s.n.* (holotype BO [BO-1600915]).

*Ternstroemia penangiana* auct. non Choisy: Ridley, Fl. Malay Pen. 1: 197 (1922), pro parte; Keng, Tr. Fl. Malaya 3: 295 (1978), pro parte.

*Distribution.* Sumatra (Aceh, Riau, Bangka-Belitung); Peninsular Malaysia (Penang, Perak, Selangor, Negeri Sembilan, Melaka, Kelantan, Pahang, Johor) and Singapore.

*Ecology.* Primary and regenerated forest in lowlands to hills up to c. 600 m elevation.

*Selected specimens.* PENINSULAR MALAYSIA: **Penang:** Government Hill, Nov 1890, *Curtis 1055* (SING0074034); West Hill, Oct 1886, *Curtis 1055* (SING0074051); ibidem, Apr. 1890, *Curtis 1055 B* (SING0074045). **Perak:** s.l. Aug 1885, *King's collector 8113* (L2405899); Batang Padang, Bkt. Tapah F.R., 3 Apr 1971, *Loh FRI17373* (KEP1908, SING0074037); Tapa[h], *Wray 1431* (SING0074042, SING0074048, SING0074055); Kuala Kangsar, Piah F.R., 16 Jul 1967, *Kochummen FRI2470* (KEP1906, SING0074035, SING0074038). **Selangor:** Gombak, Bkt. Lagong F.R., 4 Feb 1962, *Mohzan KEP94727* (KEP1904, SING0073922); Hulu Langat, Genting Temok, 16 Jan 1960, *Gadoh KL1947* (KEP1902). **Negeri Sembilan:** Port Dickson, Sg. Menyala F.R., 13 Nov 1953, *Sinclair SFN40153* (SING0074056, L2405897); ibidem, 9 Jul 1947, *Wyatt-Smith KEP64499* (KEP1907). **Melaka:** s.l., *Ridley s.n.* (SING0074040); Sg. Udang, Oct 1893, *Goodenough 1492* (SING0074050). **Kelantan:** Tamangan, Kpg. Gobek, Kerilla Estates, 1 Mar 1959, *Mohd Shah MS485* (SING0074036), *MS543* (SING0074039). **Pahang:** Raub, 30 Oct 1929, *Strugnell 20335* (SING0074049); Rompin, Lesong F.R., 29 Jun 1972, *Chan FRI16912* (KEP1598, SING0074573); ibidem, 4 May 1956, *Lindong KEP83469* (KEP1909). **Johor:** Johor Bahru, Gn. Pulai, 12 Mar 1970, *Burgess FRI9936* (KEP90086); Kluang, Kluang F.R., 21 Oct 1969, *Kochummen FRI2853* (KEP1905); ibidem, 10 May 1968, *Whitmore FRI8707* (KEP1599, SING74107); Mersing, Mersing–Endau road, 15 Sep 1969, *Kochummen FRI2803* (SING0166137); Mersing F.R., 22 Oct 1997, *Perromat KL4744* (KEP1910).

SINGAPORE: MacRitchie Reservoir, 12 Nov 1951, *Sinclair SFN3942* (SING0026358); Mandai Road, 22 Apr 1941, *Collector unknown SFN37271* (SING0017178, L2405898).

*Notes.* The true identity of many Malayan *Ternstroemia coriacea* specimens has been masked under the misapplied name *T. penangiana* auct. non Choisy since the 1920's. This species is characterised by dark brown terete twigs, stout petioles (15–25 mm long, 3–4 mm thick), smooth, leathery oblanceolate lamina (12.5–19 × 4.8–8.4 cm) that dries dark brown, ellipsoid or globose fruit on a slender pedicel (3.5–6 cm long, 2 mm thick), and a smooth calyx cup with flared lobes.

Only one specimen, BO-1600915 (BO), has been located with the locality information of 'Bangka, Batoe-Balai' and the vernacular name 'Prapat-darat = Me'ikoh' exactly as in the Scheffer (1870) protologue, and is, therefore, interpreted here as the holotype. Other Teysmann collections from the type locality are deposited in BO (BO-1600916), L (L2405910, L2405911) and U (U1742028).

**3. *Ternstroemia palembangensis*** Kobuski, J. Arnold Arbor. 44: 427 (1963). – TYPE: Indonesia, Sumatra, Palembang, Ond. Afd. Banjoeasin en Koeboestrecken bij Bajoenglintjir, *L.J.W. Dorst 69T-IP-125* (holotype BO [BO-135020]; isotypes A [A00025066] (fragm.), BO [BO-135018, BO-135019], L [L0012421]).



*Ternstroemia corneri* H.Keng, Gard. Bull. Sing. 29: 143 (1977); Keng, Tr. Fl. Malaya 3: 293 (1978); Kochumen, Tr. Fl. Pasoh For.: 426 (1997). – TYPE: Malaysia, Johor, Sungai Berassau, Mawai-Jemaluang Road, low altitude, in swampy forest, 6 Feb 1935, *E.J.H. Corner SFN28740* (holotype SING [SING0055550], isotypes A, B, BM, K [K000674016], KEP [KEP116328], L [2400447]), **synon. nov.**

*Distribution.* Peninsular Malaysia (Perak, Selangor, Negeri Sembilan, Johor); Singapore and Sumatra (South Sumatra).

*Ecology.* Lowland fresh water swamp forests or edge of streams, locally common; rarely in the valleys of hill forests.

*Selected specimens.* PENINSULAR MALAYSIA: **Perak:** Hilir Perak, Changkat Jong, 17 Feb 1976, *Sidek SK466* (KEP219637, SING0073945); Sg. Hidup, 17 Feb 1975, *Mohd Shah & Shukor MS3462* (KEP116320, SING0073944). **Selangor:** Gombak, Bkt. Lagong F.R., 16 May 1947, *Ali et al. 52239* (KEP1903). **Negeri Sembilan:** Jelebu, Pasoh F.R., 11 Aug 1988, *LaFrankie 3217* (KEP103117). **Johor:** Kota Tinggi, Mawai, 13 Apr 1936, *Corner SFN30888* (SING0073949, L2400484); *ibidem*, 13 Jan 1938, *Ngadiman SFN34736* (BO, SING0073946, L2400445, L2400446); Mawai-Jemaluang Rd., Sg. Kayu, 6 Feb 1937, *Corner SFN32245* (KEP116327, SING0073947, L2400483); Sg. Gambut, 23 Jul 1939, *Corner SFN36815* (KEP111742, SING0073950, L2400485); Sg. Sedili, Danau, 27 Mar 1932, *Corner s.n.* (SING0073948); Sg. Kayu, 23 Oct 1936, *Kiah SFN32158* (SING0073951, L2400482); 25 Jul 2006, Mersing, Lenggong F.R., *Teo & Din KL5278* (KEP126426). SINGAPORE: Mandai Forest, 6 Jan 2009, *Gwee et al. SING2009-30* (SING0116942); Nee Soon Freshwater Swamp Forest, 18 Apr 2005, *Samsuri et al. SING2005-121* (SING0061029); Upper Seletar Forest, 25 Aug 2011, *Gwee SING2011-331* (SING0166745).

*Notes.* Malayan specimens of this taxon were placed in *Ternstroemia corneri* which was regarded as a species endemic to the Malay Peninsula. However, in the diagnostic characters of vegetative bracts on young twigs and scale-like scars on older twigs, the large oblanceolate leaves (19–)23.5–36.5 cm long, and at least 12 pairs of clearly visible lateral veins on lower leaf surface, all specimens determined as *Ternstroemia corneri* match with the type material of *T. palembangensis* and other Sumatran material.

**4. *Ternstroemia wallichiana*** (Griff.) Engl. in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 1: 246 (1897); Keng, Tr. Fl. Malaya 3: 295 (1978). – *Erythrochiton wallichianum* Griff., Proc. Linn. Soc. 1: 282 (1846), Notul. Pl. Asiat. 4: 565 (1854). – TYPE. Myanmar, Mergui, Madamacan Island, Dec 1834, *W. Griffith 866* [number tag is upside down on the holotype sheet, seemingly ‘998’] (lectotype K [K000674012], designated here; isoelectotype K [K000674011]).

*Ternstroemia penangiana* auct. non Choisy: Dyer in Hook.f., Fl. Brit. India 1: 281 (1874), pro parte; Ridley, Fl. Malay Pen. 1: 197 (1922), pro parte. – *Ternstroemia wallichiana* Ridl., Fl. Malay Pen. 1: 198 (1922).

*Distribution.* India (Andaman and Nicobar Islands (Prasad et al., 2009)); Myanmar (Myeik (Mergui)); Central Thailand (Nakhon Nayok), Peninsular Thailand (Phangnga, Nakhon Si Thammarat, Satun (Ko Tarutau), Songkhla); Peninsular Malaysia (Perlis, Kedah (incl. P. Langkawi), Penang, Perak, Kelantan, Terengganu (incl. P. Redang), Pahang (incl. P. Tioman), Johor (incl. P. Tinggi)); Singapore and East Nusa Tenggara (Flores, *Kostermans* 22126, 22127 (BO)).

*Ecology.* Exposed areas such as the seashore, riversides and secondary forests.

*Selected specimens.* CENTRAL THAILAND: **Nakhon Nayok:** Muang, Khao Yai National Park, Mo Singto, 29 Mar 2002, *Tanthana & Boonkongchart* 39 (L2400316). PENINSULAR THAILAND: [Lower Siam] 17 Mar 1919, *Hamid* 3866 (SING74059). **Nakhon Si Thammarat:** s.l., 15 Sep 1960, *Sangkachand* 694 (L2400319). **Phangnga:** Ton Bariwat W.S., 11 Dec 2004, *Gardner et al.* ST1243 (KEP204682). **Satun:** Tarutao N.P., 31 Mar 2006, *Gardner* ST2530 (KEP225500). **Songkhla:** Khao Nam Khang N.P., 27 Jan 2006, *Gardner* ST2256 (KEP172002). PENINSULAR MALAYSIA: **Perlis:** Titi Tinggi, Rimba Mas Mas F.R., 5 Jun 1941, *Symington* 57049 (KEP191849). **Kedah:** Kota Setar, Tampoi F.R., 14 Jul 1947, *Wyatt-Smith* 64266 (KEP191847); Kubang Pasu, Sg. Badak F.R., 27 Apr 2006, *Teo & Din* KL5235 (KEP125591); Langkawi, G. Raya FR, G. Raya, Lubuk Sembilang, 16 Mar 1990, *Kamarudin* FRI31365 (SING0074118); P. Dayang Bunting, 12 May 1983, *Collector unknown* FRI22907 (KEP91617); ibidem, 15 Sep 1983, *Collector unknown* FRI22918 (KEP91618); Near Telaga Tujuh, 24 Feb 1983, *Kochummen* FRI26087 (KEP91616, SING0074086); Telok Datai, 21 Nov 1921, *Mohd Haniff & Mohd Nur* 7514 (SING0074058); Sik, Ulu Muda F.R., 16 Jan 1969, *Bray* FRI11523 (KEP1901, SING0074115). **Penang:** Penang Hill, *Ridley* 9351 (SING0074067); ibidem, 15 May 1934, *Henderson* SFN21301 (KEP191846, SING0074062); ibidem, 20 Apr 1938, *Kiah* SFN35324 (KEP1600, SING0074057); Government Hill F.R., 8 May 1926, *Hashim* FMS11665 (KEP191852); Government Hill, Jun 1890, *Curtis* 905 (SING0074089); ibidem, Apr 1897, *Curtis* 3283 (SING0074061); ibidem, 11 May 1926, *Mohd Hashi* 11670 (SING0074047); Waterfall Gardens, 27 Mar 1915, *Burkill* 802 (SING0074088), ibidem, Apr 1940, *Nauen s.n.* (SING0074074); West Hill road, Jun 1886, *Curtis* 905 (SING74043), Apr 1890, *Curtis* 905 (SING0074046), 905 B (SING0074052). **Perak:** Hulu Perak, Temengor F.R., Sg. Bekek Trail, 20 Feb 1994, *Chua et al.* FRI40530 (KEP191843). **Kelantan:** Kuala Krai, Stong F.R., 24 Mar 2007, *Lim et al.* FRI52931 (KEP142688, SING0109964, L4212024); Machang, Bkt. Baka F.R., 23 Oct 2008, *Teo & Din* KL5606 (KEP163734). **Terengganu:** s.l., 22 Aug 1889, *Ridley s.n.* (SING0074066); Dungun, Rantau Abang Nursery, 28 May 1986, [*Teo & Perromal*] T&P 1023 (SING0074068); Kuala Terengganu, P. Pinang, 3 Aug 1998, *Khairuddin* FRI35403 (KEP224227, SING0166136); P. Redang, Pasir Mak Simpan, 11 May 1977, *Liew* 232 (SING0074614); Kingal [Kijal?], 8 Mar 1973, *Ahmad* AS112 (SING0074064). **Pahang:** Jerantut, Kuala Tahan, 10 May 1890, *Ridley* 1425 (SING0074065); Kuantan, Balok F.R., Kpg. Balok, 28 Mar 1919, *Yeop* FMS3146 (KEP191851, SING0074090); Bkt. Galing, 24 Oct 1923, *Mahmud* FMS6685 (KEP191853); Teluk Sisek, 29 Mar 1920, *Yeop* FMS878 (KEP191850, SING0074073); Rompin, Tasik Ayer Puteh, 7 Nov 1929, *Mahamud* FMS17177 (KEP191845, SING0074087); P. Tioman, Ayer Batang, 24 May 1927, *Henderson* 18464 (KEP191842, SING0074063). **Johor:** Batu Pahat, Banang F.R., 18 Aug 1953, *Lindong & Santiago* 71527 (KEP191848); P. Tinggi, 16 May 1954, *Sinclair* SFN40285 (SING0074070). SINGAPORE: Batu Putey, 18 Jun 1890, *Goodenough* 1648 (SING0026369); Changi, 1899,

*Ridley 4646* (SING0026370); Chua Chu Kang, 1894, *Ridley 6093* (SING0026361); P. Tekong, Dec 1890, *Ridley PT1807* (BO-1604086, SING0026368), *PT1951* (SING0026371).

*Notes.* This species is distinctive in its narrowly elliptic-oblong leaves, which become reddish brown while drying and are covered with minute raised dashes on both surfaces, and the almost globose fruits with a thick and warty calyx cup.

### New records

**1. *Ternstroemia patens*** (Korth.) Choisy, Mém. Soc. Phys. Genève 14: 107 (1855); Kobuski, J. Arnold Arbor. 44: 423 (1963). – *Reinwardtia patens* Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot.: 102, t. 12 (1840/41). – TYPE: Indonesia, Sumatra, Doekoe, *P.W. Korthals s.n.* (lectotype L [L0012422], designated by Kobuski (1963: 424); prob. isoelectotypes L [L0012423], K [K000768053]).

*Distribution.* Peninsular Malaysia (Terengganu, Pahang, Johor); Sumatra (West Sumatra, Bengkulu); Java (Banten, West Java, Central Java); Borneo and Maluku.

*Ecology.* Lowland primary forest.

*Specimens examined.* PENINSULAR MALAYSIA: **Terengganu:** Setiu, Bkt. Kesing, 25 Sep 1991, *Teo & Remy KL4080* (KEP116346); ibidem, 29 Jul 1993, *Perromat & Teo KL4270* (KEP116344). **Pahang:** Rompin, Lesong F.R., 12 Jun 1979, *Chan FRI23917* (KEP116345, SING0074119). **Johor:** Kota Tinggi, Mawai–Jemaluang Road, Sg. Kayu, 14 Apr 1935, *Corner SFN29244* (SING0073953); ibidem, 17 Mar 1937, *Kiah SFN32416* (SING0073956).

*Notes.* Keng (1978) enumerated seven *Ternstroemia* species for Peninsular Malaysia and Latiff et al. (1998) added one more. The new record of *Ternstroemia patens* reported here is characterised by obovate-elliptic, medium-sized leaves (10–12.5 × 4–5.5 cm), that dry olive green with a dull yellowish green midrib contrasting with the lighter lamina, and a single-seeded ovoid fruit with a relatively small calyx cup (7 mm across).

**2. *Eurya glabra*** (Blume) Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot. 2: 114 (1841); Miquel, Fl. Ned. Ind. 1(2): 472 (1859); Kobuski, Ann. Missouri Bot. Gard. 25: 342 (1938); De Wit, Bull. Jard. Bot. Buitenz. III, 13: 350 (1947). – *Geeria glabra* Blume, Bijdr. Fl. Ned. Ind. 3: 125 (1825). – TYPE: Indonesia, Java, Mt. Gede Pangrango, near crater, *Blume s.n.* (lectotype BO, designated by De Wit (1947: 351); probable isoelectotypes L [L0624616, L0624621], GH [HUH00024968], M [M0112026, M0112027, M0112029], NY [NY003538287, NY00353828]).

*Eurya nitida* var. *siamensis* auct. non (Craib) H. Keng: Keng, Tree Fl. Mal. 3: 282

(1978).

*Distribution.* Peninsular Malaysia (Perak, Pahang, Terengganu); Sumatra (Lampung) and Java (West Java).

*Ecology.* In Peninsular Malaysia, it is known only from montane ericaceous forests on high mountains at 1000–2100 m a.s.l.

*Specimens examined.* PENINSULAR MALAYSIA: **Perak:** Kuala Kangsar, Korbu F.R., Gn. Korbu, 21 Jul 1933, *Symington FMS31464* (KEP1597). **Pahang:** Cameron Highlands, Dec 1951, *Johnston AMJ70* (SING0082584); Gn. Brinchang, 18 Aug 2006, *Kiew RK5363 A* (KEP116802, SING0092767); *ibidem*, *Whitmore FRI15417* (KEP192299); *ibidem*, 12 Aug 1986, *Wong FRI35238* (KEP1596, SING0081972, SING0082588). **Terengganu:** Gn. Padang, Jun 1937, *Moysey & Kiah SFN31046* (SING0082585).

*Notes.* Keng (1978) listed three species of *Eurya* for Peninsular Malaysia, *E. acuminata*, *E. nitida* and *E. trichocarpa*. *Eurya glabra* resembles *Eurya nitida* in its glabrous young twigs, terminal leaf buds and the outer surface of the calyx. However, *Eurya glabra* is characterised by its conspicuous 9–13 pairs of lateral veins (vs. less distinct 6–9 lateral veins in *E. nitida*), by a calyx that is densely pubescent on the inner surface and a ciliate margin (glabrous in *E. nitida*), by the 17–21 stamens (up to 12 in *E. nitida*), and in having filaments longer than the anthers (anthers longer than filaments in *E. nitida*). Neither female flowers nor fruit are known from Peninsular Malaysia. Two varieties are recognised in *Eurya glabra* (De Wit, 1947) but only the type variety occurs in Peninsular Malaysia.

ACKNOWLEDGEMENTS. The present study is part of the ‘Flora of Peninsular Malaysia Project’ funded by the Ministry of Science, Technology and Innovation (Project No. 01-04-01-0000 Khas2), and the Ministry of Natural Resources and Environment under the 10th and 11th Malaysian Plans. Curators, keepers and managers of herbaria (BM, BO, G, K, KEP, KLU, L, SING and UKMB) are thanked for allowing me to examine the specimens in their holdings, reproducing and sending images of types, making their specimen images available online, and sharing their specimen data. I thank Suzana Sabran (SAN), who is revising Bornean *Ternstroemia*, for drawing my attention to the occurrence of *T. patens* in Peninsular Malaysia. Ruth Kiew (KEP), David Middleton (SING) and two anonymous reviewers are gratefully acknowledged for their critical and constructive comments to improve the manuscript.

## References

- Anderberg, A.A., Rydin, C. & Källersjö, M. (2002). Phylogenetic relationships in the order Ericales *s.l.*: analyses of molecular data from five genes from the plastid and mitochondrial genomes. *Amer. J. Bot.* 89: 677–687.
- Corner, E.J.H. (1997). Theaceae. In: *Wayside tree of Malaya*, 4th ed., 2: 719–729. Kuala Lumpur: The Malayan Nature Society.

- Culham, A. (2007). Pentaphylacaceae. In: Heywood, V.H., Brummitt, R.K., Culham, A. & Seberg, O. (eds) *Flowering Plant Families of the World*: 248–249. London: Royal Botanic Gardens, Kew.
- De Wit, H.C.D. (1947). A revision of the genus *Eurya* Thunb. (Theac.) in the Malay Archipelago (including New Guinea and South of The Philippines). *Bull. Jard. Bot. Buitenzorg*, series III, 17: 329–375.
- Dyer, W.T.T. (1874). Ternstroemiaceae. In: Hooker, J.D. (ed) *The Flora of British India* 1: 279–294. London: L. Reeve & Co.
- Keng, H. (1978). Theaceae. In: Ng, F.S.P. (ed) *Tree Flora of Malaya* 3: 275–296. Kuala Lumpur: Longman.
- King, G. (1890). Ternstroemiaceae. *J. Asiat. Soc. Bengal* 59(2): 185–206.
- Kobuski, C.E. (1963). Studies in the Theaceae XXXIV: Some Asiatic taxa of *Ternstroemia*. *J. Arnold Arbor.* 44: 421–433.
- Latiff, A., Natrah, M. & Zainudin Ibrahim, A. (1998 [‘1996’]). *Ternstroemia magnifica* Stapf ex Ridley (Theaceae) and *Kibatalia macrophylla* (Pierre) Woodson (Apocynaceae), two species new to Peninsular Malaysia. *Gard. Bull. Singapore* 48: 195–200.
- Mabberley, D.J. (2008). *Mabberley’s Plant-Book*, 3rd edition. Cambridge: Cambridge University Press.
- Miquel, F.A.G. (1861). Ternstroemiaceae. In: Miquel, F.A.G. (ed) *Flora Indiae Batavae, supplementum primum. Prodrum Flora Sumatranae* 3: 476–482. Amsterdam: C.G. van der Post.; Utrecht: C. van der Post. Jr.; Leipzig: bij. Fried. Fleischer.
- Prasad, P.R.C., Reddy, C.S., Iakhsmi, R.K.V., Kumari, P.V., Raza, S.H. (2009). *Angiosperm of North Andaman, Andaman and Nicobar Islands, India. Check List* 5: 254–269.
- Ridley, H.N. (1922). Ternstroemiaceae. In: Ridley, H.N. (ed) *The Flora of the Malay Peninsula* 1: 192–209. London: L. Reeve & Co.
- Scheffer, R.H.C.C. (1870). Observationes phytographicae, pars II. *Natuurk. Tijdschr. Ned.-Indië* 31: 338–375.
- Stevens, P.F. (2001 onwards). Angiosperm Phylogeny Website. Version 13 (last updated on 7 July 2016). <http://www.mobot.org/MOBOT/research/APweb/> (accessed on 20 Aug. 2016).
- Thiers, B. (continuously updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden’s Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/> (accessed on 27 Aug. 2016).
- Van Steenis, G.G.G.J. (1955). Pentaphylacaceae. In: Van Steenis, G.G.G.J. (ed) *Flora Malesiana*, Series I, 5: 121–124. Jakarta: Noordhoff-Kolff N.V.
- Weitzman, A.L., Dressler, S. & Stevens, P.F. (2004). Ternstroemiaceae. In: Kubitzki, K. (ed) *The Families and Genera of Vascular Plants* 6: 450–462. Heidelberg: Springer.
- Whitmore, T.C. (1973). Pentaphylacaceae. In: Whitmore, T.C. (ed) *Tree Flora of Malaya* 2: 308. Kuala Lumpur: Longman.
- Yao, T.L. (2010). Pentaphylacaceae. In: Kiew, R., Chung, R.C.K., Saw, L.G., Soepadmo, E. & Boyce, P.C. (eds) *Flora of Peninsular Malaysia*, Series II, 1: 161–164. Kuala Lumpur: Forest Research Institute Malaysia.



## ***Impatiens* (Balsaminaceae) species from karst limestone in Kelantan, Malaysia, including three new species**

R. Kiew

Forest Research Institute Malaysia, Kepong 52109,  
Selangor, Malaysia  
ruth@frim.gov.my

**ABSTRACT.** Peninsular Malaysian *Impatiens foxworthyi* M.R.Hend. is distinct from the Thai *I. opinata* Craib. Three new *Impatiens* species are described: *I. glaricola* Kiew with purple flowers, *I. chikuensis* Kiew with pale yellow flowers, and *I. vinosa* Kiew with deep red flowers. While *Impatiens foxworthyi* is widespread on karst limestone in Kelantan and Pahang, the three new species are narrowly endemic to Kelantan limestone and are critically endangered.

**Keywords.** Balsams, conservation assessments, Peninsular Malaysia

### **Introduction**

The last account for balsams from Peninsular Malaysia was by Shimizu (1970) who recorded 14 species, of which only one, which he called *Impatiens opinata* Craib, was from Kelantan. Examination of the type of *Impatiens opinata* shows that the Kelantan balsam is distinct from it and should be called *I. foxworthyi* M.R.Hend. (see below). During a survey of limestone hills in Kelantan, three new species came to light (Davison & Kiew, 1990). They are described and illustrated here. Two resemble *Impatiens foxworthyi* in having racemose inflorescences, while the third has flowers singly from the leaf axils.

*Impatiens foxworthyi* is a striking balsam with bright canary-yellow flowers with deep crimson spots in the throat and its leaves often have a white midrib and veins. The new species exhibit a range of flower colours from pale creamy yellow with scarlet spots (*I. chikuensis*), or pale purple (*I. glaricola*) or deep ruby red flowers (*I. vinosa*), the last a unique colour for Malaysian balsams. All grow at the base of or in damp shaded gullies on karst limestone hills and the three new species are all critically endangered as a result of their narrow distributions, small population size, habitat disturbance, and lack of protected status of the limestone hills where they grow. *Impatiens foxworthyi* is widespread on several limestone hills in Kelantan, as well as in Pahang.

### **Key to balsam species in Kelantan**

- 1a. Flowers purple, single from the leaf axils ..... 3. *I. glaricola*
- 1b. Flowers creamy yellow, bright yellow or deep red, arranged on long racemes ... 2

- 2a. Leaves with 5–7 veins on either side of the midrib, intercostal veins distinct and parallel to the lateral veins; flowers deep ruby red ..... 4. *I. vinosa*
- 2b. Leaves with 3–4 veins on either side of the midrib, intercostal veins obscure; flowers creamy yellow or bright yellow ..... 3
- 3a. Leaf margin teeth tipped by a long glandular hair; flowers bright canary-yellow, petals lobes not reflexed, lower lip expanding ..... 2. *I. foxworthyi*
- 3b. Leaf margin teeth not tipped by a glandular hair; flowers creamy yellow, petal lobes reflexed and oblong ..... 1. *I. chikuensis*

**1. *Impatiens chikuensis* Kiew, sp. nov.**

It is most similar to *Impatiens foxworthyi* M.R.Hend. in its ovate leaves with c. 3 pairs of ascending veins, in the erect racemose inflorescences held above the leaves with persistent, broadly ovate bracteoles, and in the flower with a short stout curved spur; but it is clearly different in its pale yellow or creamy yellow (vs bright canary-yellow) flowers that are more narrowly tubular, the petals are strongly reflexed with an undulate margin (vs the lower petals project forward and spread out and are neither reflexed, nor undulate), its spur is 11–14 mm long, more than half the length of the dorsal sepal (vs 6–11 mm long and about a third the length of the dorsal sepal) and, in addition, the teeth on the leaf margin are not tipped by a glandular hair as they are in *I. foxworthyi*. – TYPE: Peninsular Malaysia, Kelantan, Gua Musang District, FELDA Chiku 8, 1 September 2015, limestone hill, *Noor Neknazrul et al. FRI83182* (holotype KEP; isotypes BKF, K, SING). (Fig. 1–3)

Perennial, glabrous herb. **Stems** erect, succulent, not expanded at the base nor tuberous, sparsely branched, 15–20 cm tall, in life to 15 mm diam. at the base. **Leaves** spirally arranged, crowded on the upper part of the stem; petioles c. 8 cm long; lamina broadly ovate, 10–11 × 6–6.5 cm, base cuneate and shortly decurrent into the petiole, with 2 glands adjacent to the petiole, plain green above or sometimes with white veins, fleshy in life, membranous when dry, margin shallowly serrulate, without a glandular hair terminating the tooth, apex shortly acuminate or acute; lateral veins 3 on either side of the midrib, ascending and looping toward the margin; intercostal veins obscure. **Inflorescences** racemose, axillary or subterminal, erect and held above the leaves, 14–20.5 cm long, slender, simple or two-branched, many-flowered, peduncle slender, 3.5–6 cm long. Bract pair narrowly lanceolate, 10–12 × c. 2 mm long, persistent; bracteoles pale green, oval to broadly ovate, 3–5 × 3–3.5 mm, apex acuminate, persistent. **Flowers** pale yellow or cream-coloured with a few large scarlet spots on lower petal lobes; pedicels pale green, slender, 10–20 mm long; *lateral sepals* 4, *outer pair* broadly ovate-orbicular, shallowly cucullate, greenish white, 4.5–9 × 4.5–10 mm, apex apiculate, *inner pair* narrowly lanceolate, c. 2 mm long; *lower sepal* funnel-shaped, very pale yellow, 19–23 mm long, 7–17 mm deep, margin entire with a blunt mucro at the base, abruptly constricted into the stout *spur* 11–14 mm long, strongly curved towards the apex, apex blunt (not bilobed); *dorsal petal* creamy yellow, broadly

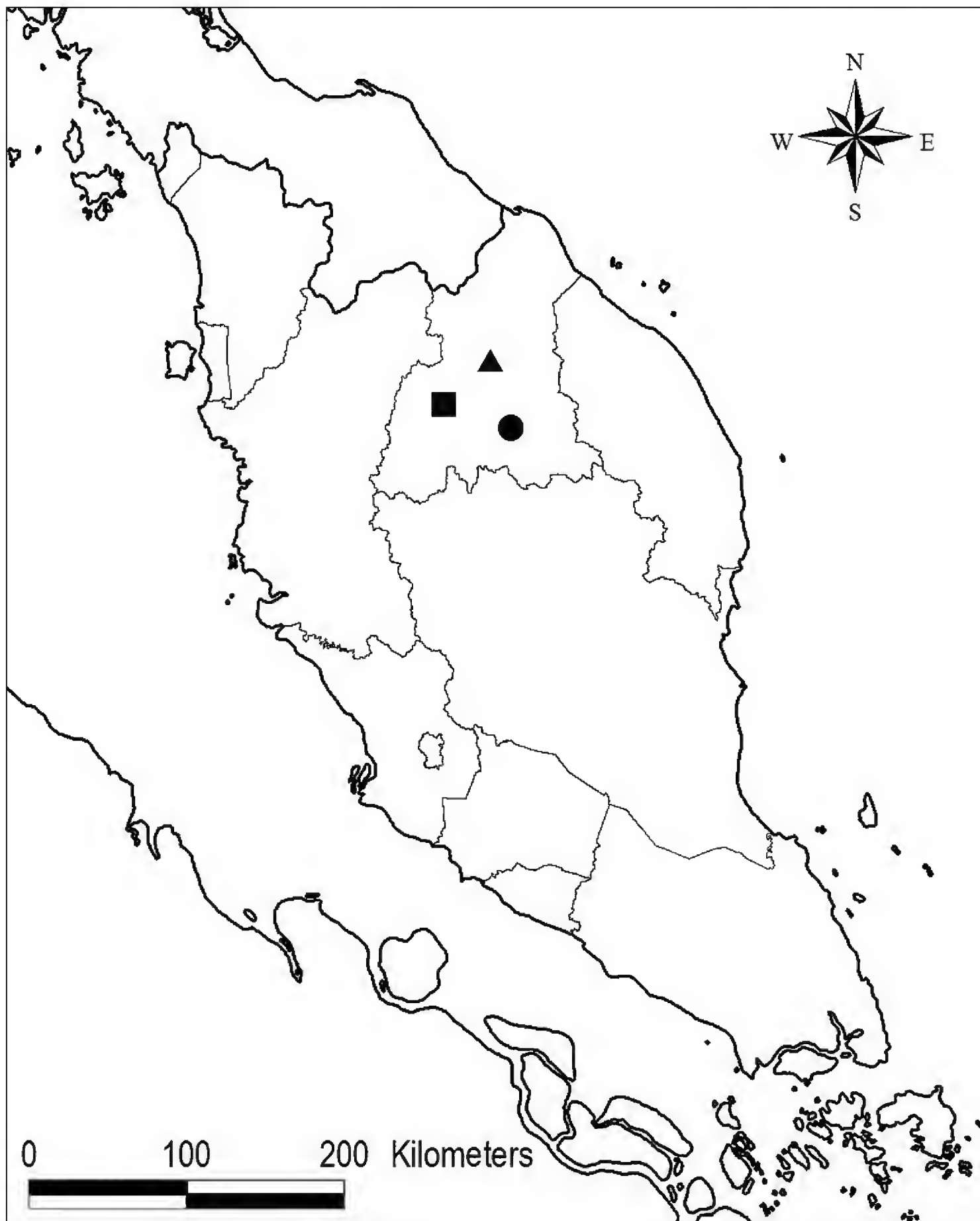




**Fig. 1.** *Impatiens chikuensis* Kiew. **A.** Plant *in situ*. **B.** Raceme with flower in front view. **C.** Raceme with flower in side view. From type locality. (Photos: P.T. Ong)

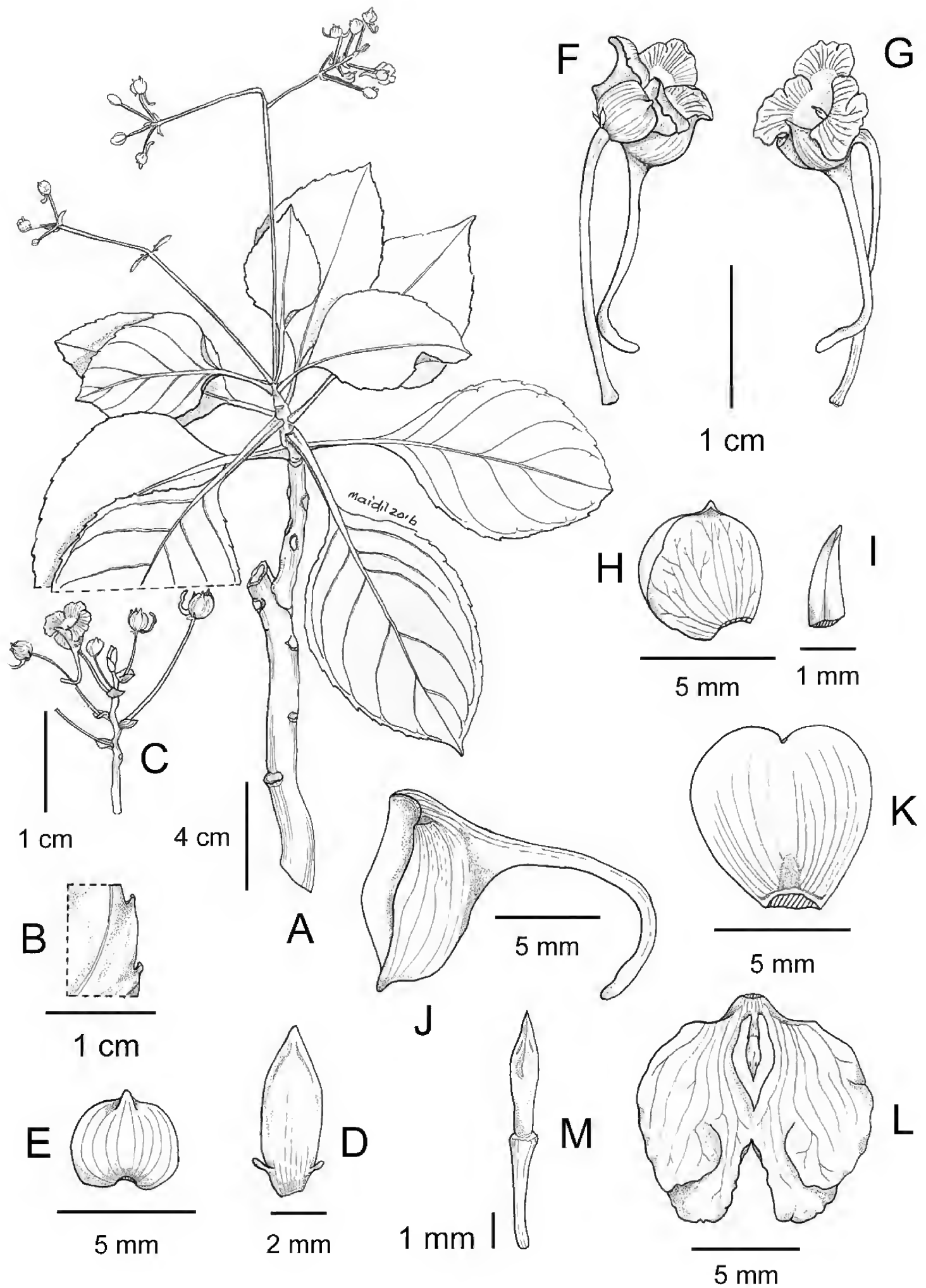
obovate, keel prominent at base, 6.5–8 × 5 mm, strongly reflexed, margin undulate, apex emarginate; *lateral petals* connate, 8–12 × 12–14 mm, split almost to the throat, strongly recurved, margin undulate, lobes almost equal, apex rounded; stamens white, c. 4–5 mm long; ovary narrowly obovoid, glabrous, c. 6 mm long, apex apiculate. *Capsules* narrowly obovoid, c. 13 mm long, 4.5–5 mm wide; pedicel 15–20 mm long.

*Distribution.* Endemic in Peninsular Malaysia. In Kelantan known only from the Chiku limestone, from two hills known as FELDA Chiku 5 and 8.



**Fig. 2.** Distribution of *Impatiens chikuensis* Kiew (●), *I. glaricola* Kiew (▲) and *I. vinosa* Kiew (■) in Peninsular Malaysia.

*Habitat and ecology.* On limestone rocks at the base of limestone karst hills in damp places in deep shade or in shaded gullies. It is nowhere common. It flowers gregariously from time to time but does not appear to flower seasonally. It has been observed in flower in January, May-June and August-September. It flowers for two to three weeks, the flowers opening one at a time, each lasting for a day or two.



**Fig. 3.** *Impatiens chikuensis* Kiew. **A.** Habit. **B.** Portion of leaf margin. **C.** Portion of raceme; **D.** Bract. **E.** Bracteole. **F.** Flower, side view. **G.** Flower, oblique front view. **H.** Outer sepal. **I.** Inner sepal. **J.** Lower sepal. **K.** Dorsal petal. **L.** Connate lateral petals. **M.** Ovary. Drawn by Mohamad Aidil Noordin from live plant.

*Provisional IUCN Conservation Assessment.* Critically Endangered A3c, B2ab(iii, iv). Known only from the Chiku limestone, a series of small karst limestone hills that lie within the FELDA oil palm estate. It is nowhere common nor is it found on every hill. The Chiku 7 & 8 hills are currently scheduled for quarrying for cement that will eventually consume the two hills completely. The other smaller hill, Chiku 5, where it is found has no legal protection and is surrounded by oil palm estate and so is isolated from the other hills and vulnerable to fires associated with agriculture, and clearing of vegetation for various purposes.

*Etymology.* Named for the only locality from where it is known, viz. FELDA Chiku limestone.

*Notes.* This species was first reported in 1990 from Chiku 5 (Davison & Kiew, 1990).

**2. *Impatiens foxworthyi*** M.R.Hend., Gard. Bull. Straits Settlem. 4: 50 (1927); Henderson, J. Malayan Branch Roy. Asiat. Soc. 17: 38 (1939); Henderson, Malayan Nat. J. 3: 35 (1948). – TYPE: Peninsular Malaysia, Pahang, Gua [Goa] Kechapi, February 1924 *Md. Nur (with Foxworthy) SFN11912* (holotype SING). (Fig. 4)

*Impatiens opinata* auct. non Craib: Shimizu, S.E. Asian Stud. 8(2): 216 (1970); Chin, Gard. Bull. Singapore 32: 96 (1979); Kiew, Malayan Naturalist 38(3): 33 (1985); Kiew in Henderson's Malaysian Wild Fl. Dicot. 173 (2014).

Perennial, glabrous herb. **Stems** erect, succulent, in life to 10 mm thick, smooth (not corky), not expanded or thickened at the base, often becoming decumbent and rooting, branched but flowering when still unbranched, 10–35(–70) cm tall, with conspicuous leaf scars. **Leaves** spirally arranged, crowded at the top of the stem; petioles 2.3–9 cm long, petioles of the lower leaves longer than the upper, with a pair of glands adjacent to the petiole; lamina broadly ovate, sometimes to elliptic, 4.5–10(–15) × 3–7.5 cm, green above, often with a broad white band along the midrib and veins, whitish green beneath, succulent, base narrowed and decurrent into petiole, margin minutely dentate serrulate; apex shortly acuminate; lateral veins 3–4 on either side of midrib, ascending steeply and joining at the margin, plane above and beneath when dry. **Inflorescences** axillary or subterminal, racemose, erect and above the leaves, (5.5–)12–30 cm long, sometimes once branched, flowers numerous at the top of the raceme, opening one at a time, peduncle succulent, pedicels slender, 1.5–2 cm in flower, lengthening to 2–2.5 cm in fruit. Bracts conspicuous, ovate, 2–4 × 1.5–2.5 mm, persistent. **Flowers** canary yellow with deep crimson to purple-black spots scattered all over the petals or, in some populations, plain white or white speckled with red spots or pale pink; *lateral sepals* 4, pale green, *outer sepal pair* ovate-orbicular, 5–8 × 4–6 mm long, yellow tinged red, slightly keeled, keel green, apex with a thick blunt mucro, *inner sepal pair* narrowly linear, c. 4 mm long; *lower sepal* funnel-shaped, pale yellow, sometimes reddish, 7–18 mm deep with a short point below, 17–35 mm long of which the stout, incurved *spur*



**Fig. 4.** *Impatiens foxworthyi* M.R.Hend. **A.** White-veined form *in situ*. **B.** Raceme with flower in front view. **C.** Raceme with flower in side view. All from *FRI20150275*. (Photos: P.T. Ong)

is 6–11 mm long, apex obtuse; *dorsal petal* ovate, 7–8 mm long, 4 mm wide, the keel prominent at base; *lateral petals* connate, 10–15 mm long and 8 mm broad, sessile, four-lobed, the lobes rounded and nearly equal, spreading wide; filaments and anthers pale cream. *Capsules* obovoid, c. 12 mm long (?mature).

*Distribution.* Endemic in Peninsular Malaysia. In Kelantan it is common in the south but has not been found north of Sungai Nenggiri. In Pahang it is less common but is found on most limestone hills.

*Habitat and Ecology.* Restricted to limestone, always in shaded areas, on boulders around the base, or on ledges or in gullies, rooting in cracks with very little soil at 30–250 m elevation. On the Chiku limestone, this species was heavily grazed by serow, *Capricornis sumatraensis* (*pers. obs.*, R. Kiew in 1990 and 2015).

*Provisional IUCN Conservation Assessment.* Least Concern. It is a widespread species, often common where it occurs.

*Etymology.* F.W. Foxworthy (1877–1950), American forester and the first forest research officer (1918–1932) in Malaya.

*Notes.* Shimizu (1970) synonymised *Impatiens foxworthyi* with *I. opinata* on the grounds that “I have only a photo of the type specimen of *I. opinata*, its description agrees well with the specimens referred to as *I. foxworthyi*”. However, examination of a type specimen of *Impatiens opinata* (Kerr 7304, BK) shows that while it resembles *I. foxworthyi* in its ovate leaves, racemose inflorescences and yellow flowers, it is very different in its thick, corky stem and expanded bulbous base, larger leaves (to 16.5 × 10 cm) and shorter inflorescence (8–13 cm). Unfortunately, the state of preservation of the flowers on the BK duplicate prevented their examination but from Craib’s description the pedicel is much shorter (7 mm long), the spur much longer (13 mm long), the dorsal petal wider (7 × 7.75 mm) and the lateral sepal longer (2 cm). *Impatiens opinata* is a rare species in Thailand, known only from the type collection and one or two other specimens that possibly belong to this species. All have the thick corky stem. Plants of *Impatiens foxworthyi* have thick, succulent green stems that are quite smooth and the base is not expanded. Therefore the Malaysian species reverts to its original name, *Impatiens foxworthyi* M.R.Hend. It is noteworthy that *Impatiens foxworthyi* grows within the equatorial zone and does not extend into the north of Malaysia that borders Thailand that experiences a monsoon climate with a distinct dry period.

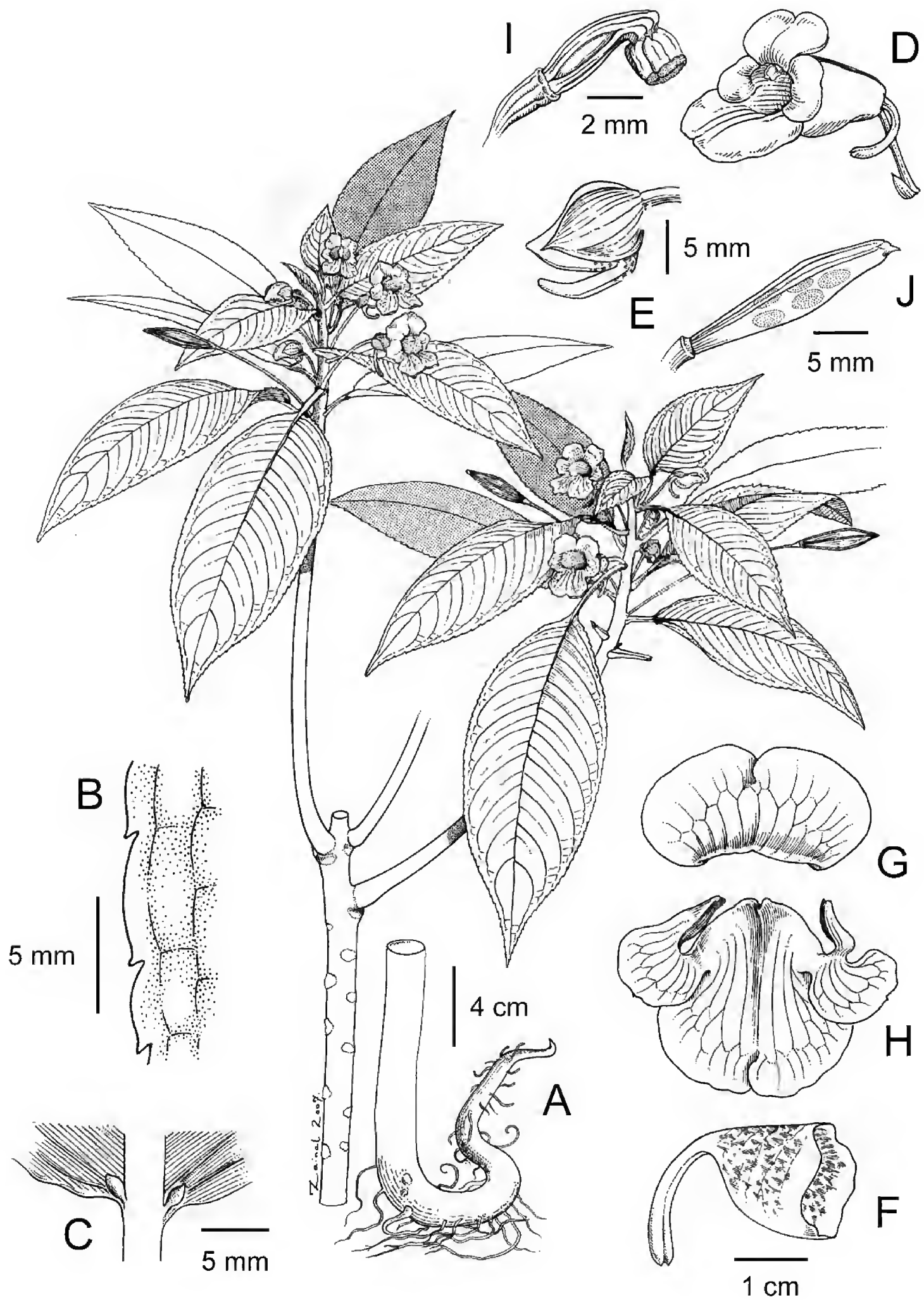
In most populations, the flower is canary yellow with deep crimson spots in the throat. However, the population on limestone in Taman Negara (Kiew, 1985) either has a plain white or pale pink flower, while scattered plants among populations of yellow-flowered *Impatiens foxworthyi* in Chiku 5 have white flowers speckled all over by tiny red spots.

*Additional specimens examined.* PENINSULAR MALAYSIA: **Kelantan:** Bukit Tapah, 16 Aug 1971, *Boey 350* (KLU); Chiku 5, 24 May 1990, *Kiew & Anthonysamy RK3106* (KEP); ibidem, 24 May 1990, *Kiew RK3095*; Chiku 8, 24 May 1990, *Kiew & Anthonysamy RK3110* (KEP); Gua Batu Boh, 4 Mar 2008, *Chew et al. FRI60155* (KEP); Gua Gagak, 21 May 1990, *Kiew & Anthonysamy RK3066* (KEP, SING); Gua Panjang, Gua Ninik, 22 Oct 1927, *Henderson SFN19558* (SING); Gua Pintu, 3 Nov 2008, *Chew & Lim FRI63402* (KEP, K); Gua Puyu, 11 Aug 2009, *Julius et al. FRI57654* (KEP, SAN); Gua Tapah, 16 Aug 1971, *Chin 1610* (KLU); Kuala Betis, 15 Feb 2003, *Kiew RK5255* (KEP, SING); Pulau Raba, 12 May 1990, *Kiew & Anthonysamy RK2912* (KEP, SING). **Pahang:** Bukit Sagu, 13 Oct 1931, *Henderson SFN26087* (SING); ibidem, 27 Nov 1984, *Kiew RK1574* (KEP, SING); ibidem, 5 May 2011, *Rafidah et al. FRI64645* (KEP); Gua Bama, 25 Aug 2008, *Mohd Hairul et al. FRI60065* (KEP); Gua Bekong, 5 Aug 1996, *Saw FRI44755* (KEP); Gua Kenyam, 2 Aug 1971, *Chin 1312* (KLU); Gua Kumbang, 29 Apr 1975, *Yap SK638* (KEP); Gua Layang, 13 Aug 1971, *Chin 1495* (KLU); ibidem, 18 Aug 1971, *Boey 303* (KLU); Gua Luas, 29 Sep 1982, *Kiew RK1200* (KEP, KLU); ibidem, 1 Oct 1984, *Kiew RK1350* (KEP); ibidem, 10 Feb 2007, *Lim et al., FRI56382* (KEP); Gua Percik, 3 Oct 2013, *Imin et al. FRI78237* (KEP); Gua Telok Gunung, 30 Sep 2013, *Imin et al. FRI77866* (KEP); Gua Ulu Rakit Gunung, 1 Oct 2013, *Imin et al. FRI77882* (KEP, SAN).

### 3. *Impatiens glaricola* Kiew, sp. nov.

Among the Malaysian balsams with solitary flowers with a short recurved spur, *Impatiens glaricola* differs from *I. macrosepala* Hook.f., which has white flowers with red markings (vs pale purple flower and pale yellow spur), 4 lateral sepals with the outer pair connate (vs 2 free lateral sepals), shorter lower sepal 12–18 mm and spur 8 mm long (lower sepal c. 33 mm long of which the spur is 16 mm long), and shorter pedicels to 1.5 cm long (vs to 4 cm long); and from *I. alboflava* Miq., which has broader leaves (3 times vs 2 times longer than wide) that dry pale yellowish brown (vs dark khaki brown), pale creamy white or white flowers red spotted in the throat (vs pale purple flower and pale yellow spur), 4 lateral sepals (vs 2 lateral sepals), and a shorter, 8–13 mm long straight spur (vs a curved spur c. 16 mm long). – TYPE: Peninsular Malaysia, Kelantan, Kuala Krai District, Gua Ikan, 14 May 1990, *Kiew & Anthonysamy RK2937* (holotype KEP; isotypes K, L, SING). (Fig. 2, 5)

Perennial, glabrous herb. **Stems** erect, succulent, smooth, 27–40(–100) cm tall, not expanded and to 2 cm thick at the base, unbranched or branching and producing a spreading crown, lateral branches to 10 cm long. **Leaves** spirally arranged, crowded near the tip of the branches; petioles succulent, 3–10 cm long; lamina elliptic to narrowly ovate, (9.5–)15–17 × 5.5–7 cm, pale green, membranous, drying tissue-paper thin, base cuneate to rounded, not attenuate into the petiole, sometimes unequal, with a pair of glands on lower surface adjacent to the petiole, margin finely dentate, apex acuminate, acumen to 1.5 cm long; midrib and veins impressed above, prominent beneath; lateral veins 9–16 on either side of the midrib, looping toward the margin. Bracts lanceolate, ovate, 2–3.5 mm long, persistent, apex acute. **Flowers** solitary, axillary, c. 1.5 cm across the mouth; pedicels to 4 cm long slender, pale brownish green; *lateral sepals* 2, free, pale green, broadly ovate, c. 12 × 7 mm long, apex acute



**Fig. 5.** *Impatiens glaricola* Kiew. **A.** Habit. **B.** Portion of the leaf margin. **C.** Pair of glands at base of lamina. **D.** Flower. **E.** Flower bud with outer sepals. **F.** Lower sepal. **G.** Dorsal petal. **H.** Connate lateral petals. **I.** Stamens. **J.** Ovary. Drawn by Zainal Mustapa from live plant.



to apiculate; *lower sepal* broad and funnel-shaped, c. 33 mm long, white merging into pale orange, c. 20 mm deep, abruptly constricted into a slender, downward curved, pale yellow *spur* c. 16 mm long, c. 3 mm wide, apex bilobed, notch 3 mm deep; *petals* pale grey-purple, lower petals with fine golden yellow lines running into the throat, throat speckled with crimson spots; *dorsal petal* broad, erect to slightly recurved, c. 10 × 22 mm, apex emarginate; *lateral petals* connate, upper petal of each pair broadly rounded, c. 8 × 13 mm, reflexed, lower petals connate and forming a broad oblong lip, c. 18 × 17 mm, projecting more-or-less horizontally, apex emarginate, shallowly lobed; ovary glabrous. **Capsules** narrowly ellipsoid, apex apiculate.

*Distribution.* Endemic in Peninsular Malaysia, known only from Gua Ikan, Kelantan.

*Habitat and ecology.* Restricted to damp limestone boulders forming a scree at the base of a limestone karst hill, in light or deep shade, locally common.

*Provisional IUCN Conservation Assessment.* Critically Endangered B2ab(iii, iv). It is known from a single karst limestone hill where it is restricted to a single scree slope of jumbled boulders. This is adjacent to the cave which is a popular recreational area so the balsam population is threatened by disturbance caused by recreational activities. The hill has no legal protection.

*Etymology.* Latin, *glara* = scree + *-icola* = dwelling, from its habitat.

*Additional specimen examined.* PENINSULAR MALAYSIA: **Kelantan:** Gua Ikan, 18 Feb 2003, Kiew RK5266 (K, KEP, L, SING).

*Notes.* This is one of the most attractive balsams in Peninsular Malaysia with its large purple flowers. In spite of the comprehensive survey of Kelantan limestone hills (Davison & Kiew, 1990), this species was not discovered on any other hill. Another purple-flowered balsam has been reported from northern Peninsular Malaysia by Morgan (2007) who provided photographs of its flowers and a brief description. In its small leaves, 5–6 × 3–5 cm, lower sepal that narrows into a short claw-like spur it is different from either *Impatiens alboflava*, *I. glaricola* or *I. macrosepala*, and is quite likely to prove to be a new species. At present no Malaysian material of this taxon is available.

Species with flowers with a short, recurved spur, such as *Impatiens alboflava*, which Shimizu (1970) referred to as *I. scortechini* Hook.f., and *I. macrosepala*, have four lateral sepals, an outer pair that encloses the lower sepal, and an inner pair that is inconspicuous, linear and a few millimeters long. In *Impatiens glaricola*, the inner pair is lacking.

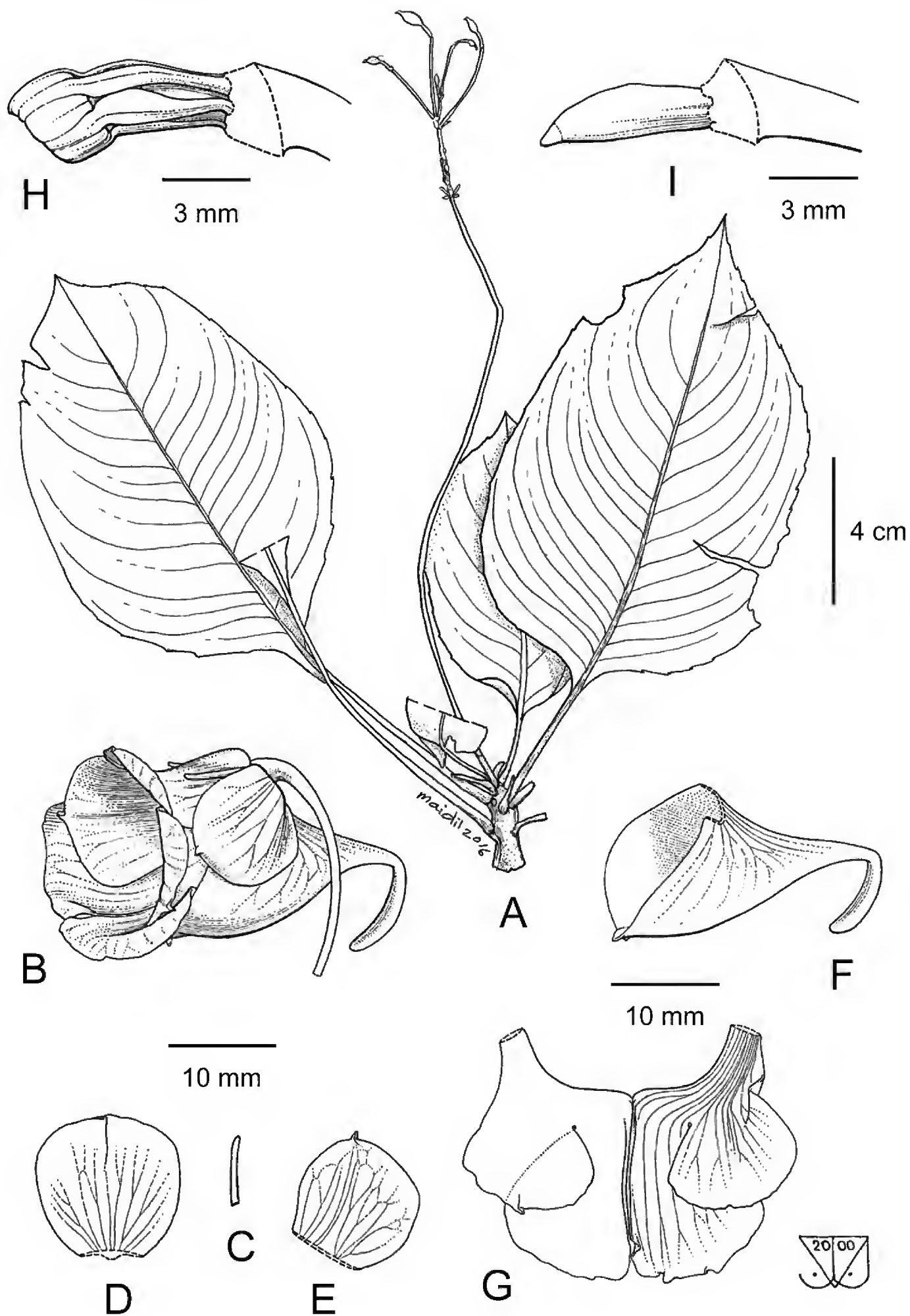
#### 4. *Impatiens vinosa* Kiew, sp. nov.

In its raceme, spirally arranged leaves and short spur strongly incurved at the tip,

it is similar to the yellow-flowered *Impatiens mirabilis* and *I. foxworthyi*. *Impatiens mirabilis*, the gouty balsam, has a massive enlarged tuberous base and a thick trunk-like stem to 2 m high. In habit, *Impatiens vinosa* is more like *I. foxworthyi* but differs in stouter stem which in life is 8–20 mm thick (vs 10 mm thick in *I. foxworthyi*) that becomes thickened at the base, broader lamina 7–9.5 cm wide (vs 3–7.5 cm wide), venation with 5–7 lateral veins on either side of the midrib with very fine parallel veins between (vs 3–4 veins and without any intervening fine veins), flowers deep ruby red or dark red wine-coloured (vs bright yellow with crimson spots), and spur 12–14 mm long (vs 6–11 mm long). – TYPE: Peninsular Malaysia, Kelantan, Gua Musang District, Sungai Nenggiri, Gua Jaya, 13 May 1990, Kiew & Anthonysamy RK2936 (holotype KEP; isotype SING). (Fig. 2, 6)

Robust perennial, glabrous herb. **Stems** 50–75 cm tall, sometimes once branched, erect or becoming decumbent, stout and succulent, to 2 cm thick, base becoming woody and up to 4 cm thick, not expanded at the base. **Leaves** spirally arranged, crowded near the top of the stem; petioles 6–9(–14) cm long, c. 3 mm thick; lamina fleshy, broadly ovate, 8–13.5 × 7–9.5 cm, plain bright green, midrib sometimes white, white beneath, base truncate to broadly rounded, shortly attenuate into the petiole, with a pair of glands on the lower surface adjacent to the petiole, margin distantly and minutely dentate; apex shortly acuminate, acumen 3–10 mm long; lateral veins 5–7 on either side of the midrib, in dry leaf plane above and slightly prominent beneath, between and parallel to the lateral veins an even finer vein that peters out before reaching the margin. **Inflorescences** racemose, axillary or subterminal, erect and held above the leaves, 19.5–22 cm long, not branched, many-flowered, peduncle ridged and 4-angled in cross section. Bract pair narrowly lanceolate, c. 5 × 1.5 mm, persistent; bracteoles broadly lanceolate, c. 3 × 2.5 mm, caducous. **Flowers** deep ruby red or dark red wine-coloured; pedicels slender, c. 15–30 mm long; *lateral sepals* 4, *outer sepal pair* deep crimson, tinged green or pale green, ovate-orbicular, 10–12 × 7–11.5 mm long, apex mucronate, *inner sepal pair* linear, c. 4 mm long; *lower sepal* funnel-shaped, reddish green or pale green tinged red, 18–35 mm long, 13–17 mm deep, margin entire, narrowing abruptly into the curved reddish brown or pale green or cream-coloured *spur* 10–14 mm long, 1–1.5 mm thick, apex obtuse (not bilobed); *petals* ruby red or dark red wine-coloured, throat greenish-yellow or cream-coloured with a few fine red lines and tiny spots, *dorsal petal* broadly ovate, c. 12 × 13 mm, deep crimson; *lateral petals* connate, c. 24 mm long, *upper petal pair* reflexed, broadly rounded and overlapping the lower petal, 7–9 × 11–12 mm, *lower petal pair* broadly oblong, 14–17 × 20–26 mm, apical notch c. 5 mm deep; stamens pale green, c. 7–8 mm long; ovary glabrous, narrowly ovoid, c. 6 mm long, apex acute. **Capsules** dark green with 4 white longitudinal lines, obovoid, c. 15 × 5–7 mm, apex apiculate, pedicel 20–23 mm long.

**Distribution.** Endemic in Peninsular Malaysia. In Kelantan, known only from Sungai Bring, and Gua Chawan and Gua Jaya above the Sungai Nenggiri.



**Fig. 6.** *Impatiens vinosa* Kiew. **A.** Habit. **B.** Flower, side view. **C.** Inner sepal. **D.** Outer sepal. **E.** Dorsal petal. **F.** Lower sepal. **G.** Connate lateral petals. **H.** Stamens. **I.** Ovary. A & C from *FRI4245*, B, D–H from live plant. A & C drawn by Mohamad Aidil Noordin; B, D–H drawn by J.J. Vermeulen.

*Habitat and ecology.* Restricted to limestone karst hills, locally very common on jagged limestone, on shaded ledges on cliffs or on the flat top of boulders at the base of hills.

*Provisional IUCN conservation assessment.* Critically Endangered B2ab(iii). The Sungai Bring is threatened by siltation and flooding due to logging upstream and the forest surrounding the limestone hills does not fall within the network of Totally Protected Areas.

*Etymology.* Latin, *vinosa* = wine-red, referring to the flower colour.

*Additional specimens examined.* PENINSULAR MALAYSIA: **Kelantan:** Sungai Bring, 11 May 1990, Kiew & Anthonysamy RK2910 (KEP, SING); Sungai Nenggiri, Gua Jaya, 27 Jul 1967, Whitmore FRI4245 (KEP); Sungai Nenggiri, Gua Chawan, 13 Mar 2000, Kiew RK4913 (KEP, SING).

*Notes.* *Impatiens vinosa* is the only indigenous balsam in Peninsular Malaysia with deep wine-red flowers; all the others have pale purple, peachy orange, bright yellow or white ones.

ACKNOWLEDGEMENTS. The study is part of the research carried out for the *Flora of Peninsular Malaysia* project under ‘Safeguarding the Forest Plant Diversity of Peninsular Malaysia’ Project No. 01-04-01-000 Khas 2 and Intensified Research in Priority Areas Grant 50282 funded by the Ministry of Science, Technology and Innovation. Thanks are due to the Carlsberg Foundation for providing accommodation that enabled me to visit BK and BKF. I thank the Malaysian Nature Society for the use of a 4-wheel drive vehicle for the 1990 survey and to G.W.H. Davison, S. Anthonysamy and all the field staff from the Kepong Herbarium who helped in the surveys, to Ong P.T. for permission to use his photographs, to En. Mohamad Aidil Noordin, J.J. Vermeulen, and Zainal Mustafa for the botanical plates, and to Joanne P.C. Tan for nurturing the balsams in the nursery. I am indebted to the curators of the herbaria in BK, BKF, BM, K, KLU, PSU and SING for permission to examine specimens in their care.

## References

- Davison, G.W.H. & Kiew, R. (1990). Survey of the Flora and Fauna of Limestone Hills in Kelantan with Recommendations for Conservation. Unpublished report. Pp. 98. Kuala Lumpur: Malayan Nature Society.
- Kiew, R. (1985). The limestone flora of the Batu Luas area, Taman Negara. *Malayan Naturalist* 38(3): 30–38.
- Morgan, R.J. (2007). *Impatiens: The Vibrant World of Busy Lizzies, Balsams, and Touch-me-nots*. Pp. 219. Portland: Timber Press.
- Shimizu, T. (1970). Contributions to the Flora of Southeast Asia. II. *Impatiens* of Thailand and Malaya. *S.E. Asian Stud.* 8(2): 187–217.

## The Calcarea group of *Begonia* (Begoniaceae) from Borneo, including four new species from Sarawak

R. Kiew<sup>1</sup>, S. Julia<sup>2</sup> & C.Y. Ling<sup>2</sup>

<sup>1</sup>Forest Research Institute Malaysia, Kepong 52109,  
Selangor, Malaysia  
ruth@frim.gov.my

<sup>2</sup>Botanical Research Centre, Sarawak Forestry Corporation,  
Kuching, Sarawak, Malaysia  
juliasang@sarawakforestry.com  
cyling@sarawakforestry.com

**ABSTRACT.** Four new species, *Begonia kanaensis* Kiew & C.Y.Ling, *Begonia lingiae* S.Julia, *Begonia rubrotepala* S.Julia and *Begonia sadirensis* Kiew & S.Julia are described from Sarawak, Borneo. Notes on habitat, distribution and additional specimens examined for *Begonia calcarea* and *B. sabahensis* are also provided. A key to the species in the ‘calcareum group’ is provided. The status of the ‘calcareum group’ as belonging to *Begonia* sect. *Diploclinium* or to a new section is discussed. A provisional conservation status is assigned to each species.

**Keywords.** Begonias, conservation status, sections

### Introduction

The most striking feature of the ‘calcareum group’ of begonias in Borneo is flower colour. While the great majority of Bornean begonias have pale pink or white flowers, in this group flower colour ranges from canary yellow, to orangey yellow, to orangey red to bright red.

The first species described in the ‘calcareum group’ was *Begonia calcarea* (Ridley, 1906) and it has proved to be the most widespread, being recorded from the Bintulu, Bau, Kapit, Kuching and Tatau districts in Sarawak. The second, *Begonia sabahensis*, was described from Sabah (Kiew & Tan, 2014). Because the two species are different from the more than 200 other Bornean species, Kiew et al. (2015) assigned this group to ‘doubtful affinity’ and suggested that these yellow/orange/red-flowered species belong to their own, as yet undescribed, section, here informally called the ‘calcareum group’. Recently a further four new species were discovered in Sarawak (Fig. 1).

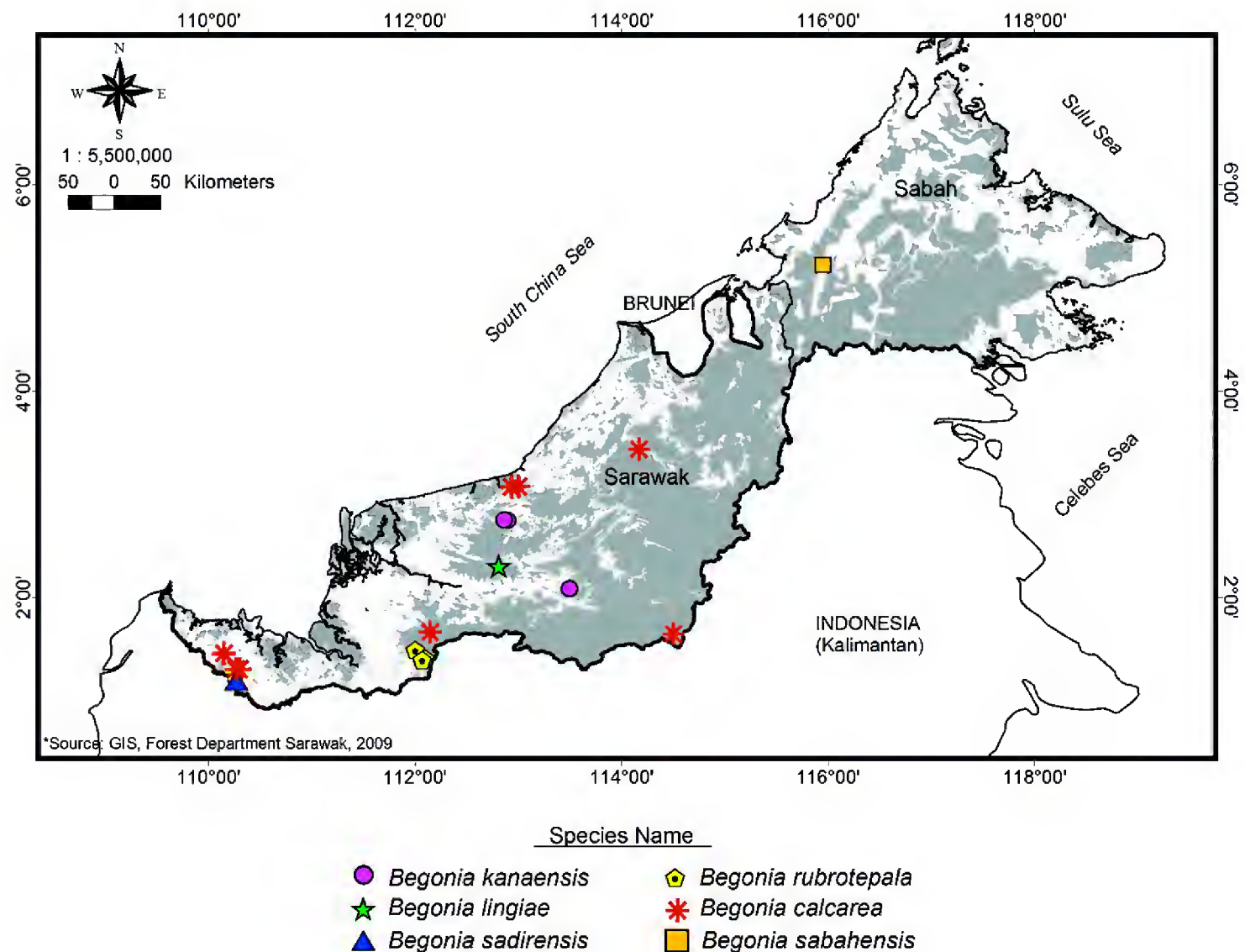
Species in this group are characterised not only by flower colour but also by a distinct combination of characters that includes the prostrate rhizome; erect, succulent, extremely hispid petiole; the more or less ovate, succulent lamina 8–17.5 × 6–19 cm; separate short, erect male and female inflorescences produced from the prostrate rhizome at ground level (except in *Begonia rubrotepala* that is atypical in producing male and female flowers on long, slender inflorescences trailing on the soil,

rather in the manner of geocarpic figs or runners with only the small apical portion erect); the male inflorescences are 3–6-flowered cymes, sometimes condensed and appearing umbellate; the female inflorescences are single-flowered or, in *B. sadirensis*, a compound cyme; the male flower has four rather fleshy tepals that are broad and more or less isomorphic (except for *B. rubrotepala*); stamen number ranges between 17–47; and flower colour in the male and female flowers is the same, with species in this group having canary yellow, orangey yellow, orangey red or bright red flowers.

Except for *Begonia kanaensis* and *B. sabahensis* that grow from lowland forest to lower montane forest up to 1500 m elevation, most species grow in lowland habitats below 500 m elevation. Most are found in rocky habitats, often near rivers and streams. *Begonia calcarea* grows on a variety of substrates including on limestone or mudstone, *B. lingiae* and *B. sadirensis* grow on sandstone rocks, while *B. rubrotepala* grows on sandy loam soils to within 5 m of the water's edge in riparian forest.

#### Key to *Begonia* species in the 'calcarea group'

- 1a. Upper surface of laminas conspicuously hairy ..... 2
- 1b. Upper surface of laminas glabrous or with occasional hairs ..... 4
  
- 2a. Leaves crowded in a tuft; female tepals c. 6 × 7 mm; capsules 11–21 × 15–21 ....  
..... *B. calcarea*
- 2b. Leaves spaced with internodes 1–10 cm long; female tepals 10–15 × 5–7 mm;  
capsules 8–12 × 11–15 mm ..... 3
  
- 3a. Laminas longer than wide, 8–12.5 × 6–11.5 cm, petioles to 8.5 cm long; flower  
yellow tinged orange; capsules 10–12 × 12–15 mm ..... *B. lingiae*
- 3b. Laminas as wide or wider than long, 8.5–13 × 8.5–16.5 cm, petioles 10–25 cm  
long; flower bright red; capsules 8–9 × 11–12 mm ..... *B. rubrotepala*.
  
- 4a. Lamina longer than wide, 8–13 × 6–10.5 cm, basal lobe 0.5–2 cm long; male  
tepals more than 1.5 times longer than wide, 12–14 × 6–8 mm ..... *B. kanaensis*
- 4b. Lamina as wide or wider than long, 8.5–16.5 × 8.5–18.5 cm, basal lobe well-  
developed 1–5 cm long; male tepals less than 1.5 times longer than wide, 5–14 ×  
4–13 ..... 5
  
- 5a. Lamina 13–17.5 × 13.3–19 cm; stipule c. 5 mm long; flowers deep orangey  
red; male and female flowers produced on the same inflorescences; male tepals  
isomorphic, 5–8 × 4–7 mm ..... *B. sadirensis*
- 5b. Lamina 9–10.5 × 9–12 cm; stipule 7–15 mm long; flowers bright yellow; male and  
female flowers produced on separate inflorescences; male tepals dimorphic, outer  
tepals 12–14 × 9–11 mm, inner tepals 11–13 × 8–13 mm ..... *B. sabahensis*



**Fig. 1.** Species distribution in Borneo.

### Species treatment

**1. *Begonia calcarea*** Ridl., J. Str. Br. Roy. As. Soc. 46: 260 (1906); Kiew & Geri, Gard. Bull. Singapore 55: 115 (2003); Kiew et al., Guide to Begonias of Borneo 68 (2015). – TYPE: Sarawak, Gunung Bra'ang, Haviland *s.n.* (holotype K). (Fig. 2)

*Distribution.* Endemic in Sarawak where the species is widespread in the Bau, Bintulu, Kapit, Kuching and Tatau districts but occurring in small populations.

*Habitat.* The species grows in lowland forests on limestone or mudstone substrates.

*Conservation status.* Least Concern. The species is widespread in Sarawak and occurs in a Totally Protected Area (Lanjak Entimau Wildlife Sanctuary) where there are no current threats.

*Note.* Flower colour is variable in this species, ranging from peachy orange to deep red.

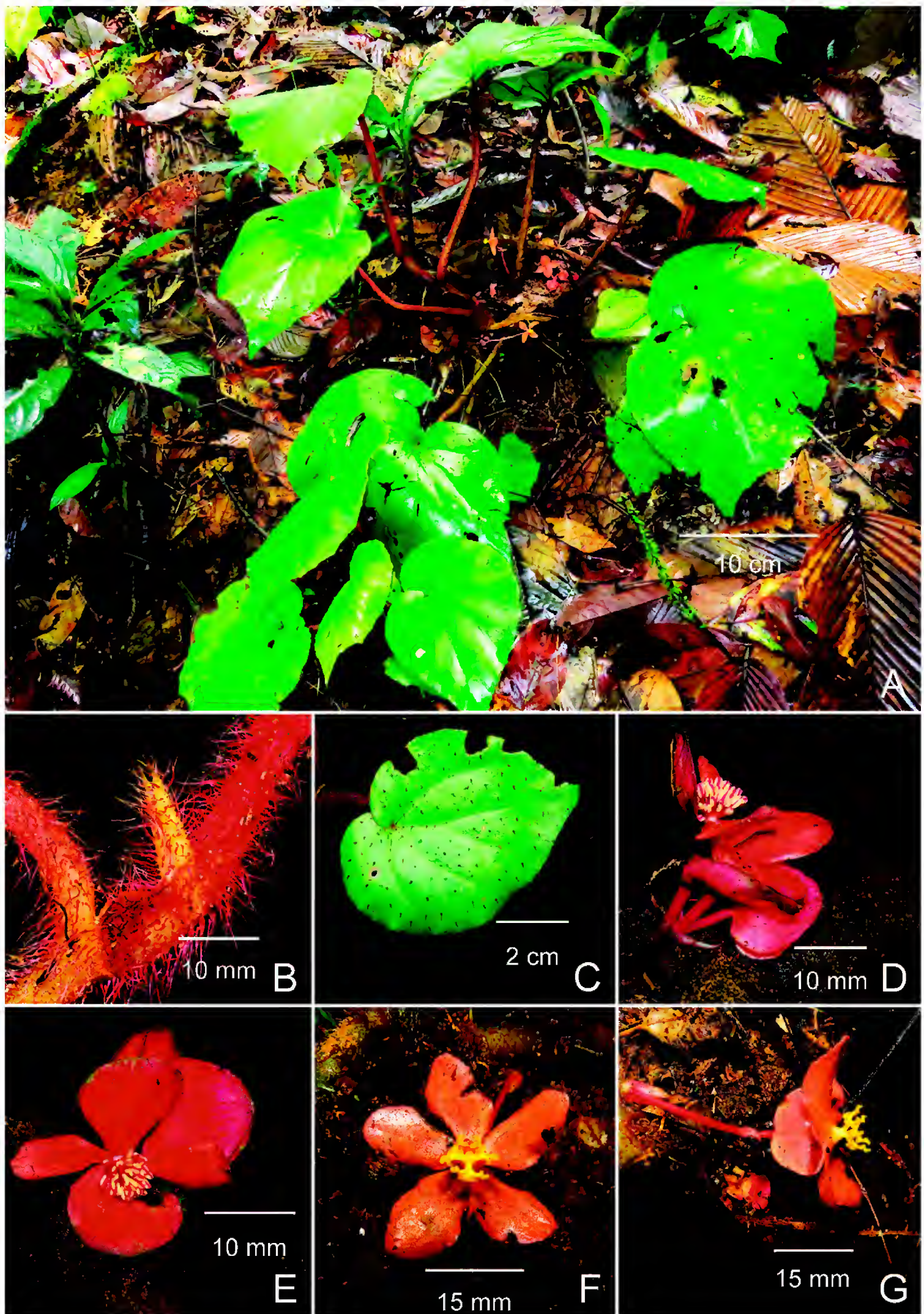
*Additional specimens examined.* MALAYSIA: **Sarawak:** Bintulu District, Ulu Segan, 28 Aug 1968, *Ilias S27245* (SAR!); Tatau District, Bukit Setiam, 11 Jul 2014, *Julia et al. SFC4218* (SAR!), 12 July 2014, *Julia et al. SFC4229* (SAR!); Kapit District, Baleh River, Sungai Sedampa, 16 Jul 1969, *Anderson S28853* (SAR!), east slope of Hose Mt., Ulu Sg. Merirai, Batang Baleh, 28 Mar 1987, *Yii et al. S53736* (SAR!); Julau District, Sungai Mujok, 22 May 2016, *Ling & Dino, SFC5936* (SAR!); Kuching District, Padawan, Bukit Angob, 38 miles from Kuching, 6 March 1969, *Anderson S27513* (SAR!), Padawan, Bukit Manok, 13 May 1975, *Burt 8134* (SAR!); Bau District, Gunung Meraja, 17 May 1975, *Burt 8154* (SAR!).

## 2. *Begonia kanaensis* Kiew & C.Y.Ling, **sp. nov.**

Similar to *Begonia sabahensis* Kiew & J.H.Tan in its prostrate habit, glabrous leaves, separate male and female inflorescences produced from the prostrate stem and the yellow flowers, but it is different in its more oval lamina 8–13 × 6–10.5 cm with the short basal lobe 0.5–2 cm long (vs. more rotund lamina 9–10.5 × 9–12 cm with a well-developed basal lobe 2–4 cm long in *B. sabahensis*), longer male and female inflorescences c. 7.5 cm long and 2–3.5 cm long respectively (vs. c. 3.3 cm long in male and c. 1.5 cm long in female inflorescences) and narrower male tepals 12–14 × 6–8 mm (vs. 11–14 × 8–13 mm). – TYPE: Borneo, Sarawak, Tatau District, Sungai Kana, 21 June 2015, *Ling et al. SFC6151* (holotype SAR!; isotype KEP!). (Fig. 3)

Creeping herb, rooting at nodes. **Indumentum:** hirsute on stems, stipules and petioles, hairs red to whitish, to c. 2 mm long, denser on petioles and young shoots. **Rhizome** red-brown, unbranched, succulent, 4–5.5 mm thick, internodes 2.8–4 cm long, slightly thicker at nodes. **Stipules** pale green, ovate to oblanceolate, 5–12 × 5–6 mm, margin entire, apex acuminate, acumen 1–2 mm long, persistent. **Leaves** alternate, distant, oblique, held more or less vertically; petioles red-brown to pale brown, 6–12(–21) cm long, terete; lamina plain green above, paler beneath, in life succulent, glossy, glabrous above and beneath, asymmetric, broadly ovate, 8–13 × 6–10.5 cm, broad side 4–6.2 cm wide, base cordate, occasionally overlapping, basal lobes 0.5–2 cm long, margin entire and fringed by sparse stiff hairs, apex acuminate, acumen 1–1.5 cm long; venation pinnate-palmate, veins greenish above, pale green beneath, 2 pairs at the base, 2–3 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent and sparsely hispid beneath, hairs red. **Male and female inflorescences** separate, produced from leaf axils of the prostrate rhizome. **Male inflorescence** a cyme, 9.5–10.5 cm long, with up to 3 male flowers; peduncle 5–7.5 cm long. **Female inflorescence** with a single female flower; peduncle 1.8–3.6 cm. **Bracts** pale green, lanceolate, 3–5 × 1–1.5 mm, margin entire, glabrous, persistent; bracteole oval, 1.5–2 × 0.7 mm. **Male flowers:** pedicel pinkish, 22–38 mm long, glabrous; tepals 4, yellow to deep yellow, glabrous, broadly elliptic, 12–14 × 6–8 mm, margin entire, apex broadly acute to rounded; stamens 17–24, cluster globose, torus c. 0.75 mm long, filaments pale yellow, 1.5–2 mm long, anthers lemon yellow, ellipsoid, 1–1.5 mm long, apex emarginate. **Female flowers** not seen. **Capsules** pale green or pinkish, 13–18 × 10–19 mm, beak 2–3 mm long, glabrous, locules 3, placentas 2 per locule, wings 3, equal, narrowed proximally into the pedicel and distally into the beak, 2.5–6 mm





**Fig. 2.** *Begonia calcarea* Ridl. **A.** Habit. **B.** Stipule and stem. **C.** Upper surface of leaf. **D.** Male inflorescence. **E.** Male flower. **F, G.** Female flower. **A, F & G** from *SFC* 5936; **B–E** from *SFC*4229. (Photos: C.Y. Ling)

wide, thinly fibrous, dehiscing between locule and wing; peduncle in fruit 1.3–4.5 cm, straight; pedicel in fruit erect, 4–5 mm long.

*Etymology.* Named after the locality from where the type specimen was collected.

*Distribution.* Borneo, Sarawak. Endemic to Sarawak (Kapit and Tatau districts).

*Habitat.* In lowland or lower montane dipterocarp forest at 190–1500 m elevation. Creeping on deep shaded rocky bank near waterfall.

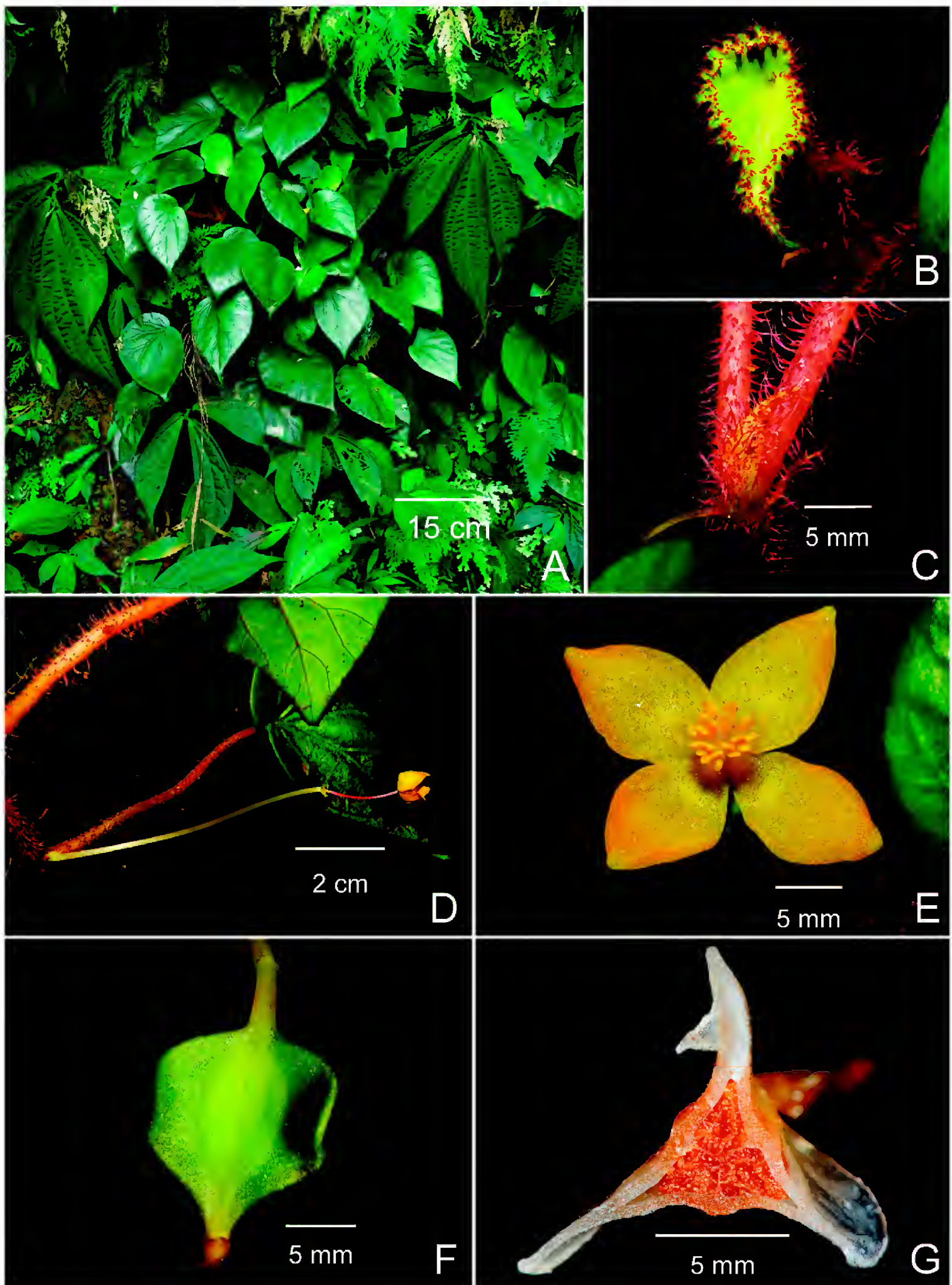
*Conservation status.* Endangered (EN B2ab(iii)). The species is known only from two localities in Kapit and Tatau Districts. In Tatau, the locality lies within the conservation area of Bukit Kana Management Area; elsewhere, the habitat is threatened due to local disturbance.

*Additional specimens examined.* MALAYSIA: **Sarawak:** Tatau District, Ulu Sangan, Bukit Kana, 14 Oct 1994, *Yii et al.* S67062 (SAR!); Kapit District, Hose Mountains, Bukit Nibong, 3 Apr 1980, *Burt* 12776 (E!, SAR!).

### 3. *Begonia lingiae* S. Julia, *sp. nov.*

Similar to *Begonia calcarea* in its hispid stems and petioles, succulent hairy laminae, male and female inflorescences from the prostrate stems, and its orangey yellow flowers, but it is different in its longer internodes 1–2 cm long and spaced leaves (vs. crowded into a tuft in *B. calcarea*), shorter petioles to 8.5 cm long and laminae 8–12.5 × 6–11.5 cm (vs. petioles 14–37 cm long and laminae 10–14 × 10–17 cm), much longer female tepals 12–15 × 5–7 mm (vs. c. 6 × 7 mm) and narrower capsules 10–12 × 12–15 mm with a prominent beak c. 2 mm long (vs. capsules 11–21 × 15–21 without a beak). – TYPE: Borneo, Sarawak, Tatau District, Anap Muput Forest Management Unit, Coupe 15, 22 June 2015, *Ling et al.* SFC6161 (holotype SAR!; isotype KEP!). (Fig. 4)

Creeping herb, rooting at nodes. **Indumentum:** hispid on stems, stipules and petioles, hairs dark red or sometimes white, c. 3 mm long. **Rhizomes** prostrate, pale green, unbranched, succulent, in life 5–6 mm thick, internodes 1–2 cm long, not thicker at nodes. **Stipules** pale green, ovate, 5–15 × 6–10 mm, margin entire, apex setose, seta 1–2 mm long, persistent. **Leaves** alternate, distant, oblique, held horizontally; petioles pale brown to pale green, 3.5–8.5 cm long, terete; lamina plain green above, pale green beneath, with scattered erect stiff hairs 1.5–2 mm long on both surfaces, in life succulent, matt, asymmetric, ovate, 8.5–12.5 × 6–11.5 cm, broad side 4.5–7 cm wide, base cordate, sometimes slightly overlapping, basal lobes 3–4.5 cm long, margin with scattered stiff hairs appearing minutely dentate, apex acuminate, acumen 1–1.5 cm long; venation pinnate-palmate, veins greenish on both surfaces, 4–7 veins on either side of the midrib, 3–4 veins in basal lobe, slightly impressed above, prominent



**Fig. 3.** *Begonia kanaensis* Kiew & C.Y.Ling. **A.** Habit. **B.** Young leaf. **C.** Stipule. **D.** Male flower with long peduncle. **E.** Male flower with isomorphic tepals. **F.** Fruit. **G.** Cross-section of fruit. From the type *SFC6151*. (Photos: C.Y. Ling)

beneath. *Male and female inflorescences* separate, produced from the leaf axils from the prostrate rhizome. *Male inflorescence* a cyme, c. 5.5 cm long; peduncle 2.3 cm long, pale pink to slightly yellowish. *Female inflorescence* with a single flower, peduncle 1–2 cm long. *Bracts* pale green, ovate to lanceolate, 2–4 × 2–4 mm, margin entire, persistent; bracteoles similar to bracts, pale green, 2–2.5 × 1–1.5 mm, margin entire, persistent. *Male flowers*: pedicel pinkish, c. 20 mm long, glabrous; tepals 4, yellow to deep yellow, tinged orange at the margin, glabrous, outer 2 tepals broadly elliptic, 9–10 × 7–8 mm, margin entire to minutely serrate, apex broadly acute to rounded, inner 2 tepals obovate to broadly oblanceolate, 8–9.5 × 5–6.5 mm; stamens c. 23, cluster globose, sessile, filaments pale yellow, 1.5–2 mm long, anthers lemon yellow, ellipsoid, 1–1.5 mm long, apex emarginate. *Female flowers*: pedicel pale green, 2–3 mm long, glabrous; tepals 5, pale green when young, yellow tinged orange at apex when open, glabrous, obovate, 12–15 × 5–8 mm, margin entire or sometimes minutely toothed, apex acute; ovary pale green tinged pink at wings, broadly obovate, 10–13 × 13–16 mm, glabrous, beaked to 3 mm long, wings 3, equal, locules 3, placentas 2 per locule; styles 3, pale yellow, 4–5 mm long, divided to base, deeply Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. *Capsule* single, 10–12 × 12–15 mm with a beak c. 2 mm long, glabrous, locules 3, wings 3, equal, broadly acute proximally, rounded to truncate distally, 3–5 mm wide, thinly fibrous, dehiscing between locule and wing; peduncle in fruit 1–2 cm long, slightly pendent, pedicel in fruit 0.2–1 cm long.

*Etymology*. Named for Ling Chea Yiing (1983–present), research officer specialising in orchid taxonomy, in Sarawak Forestry Corporation, who first collected the species.

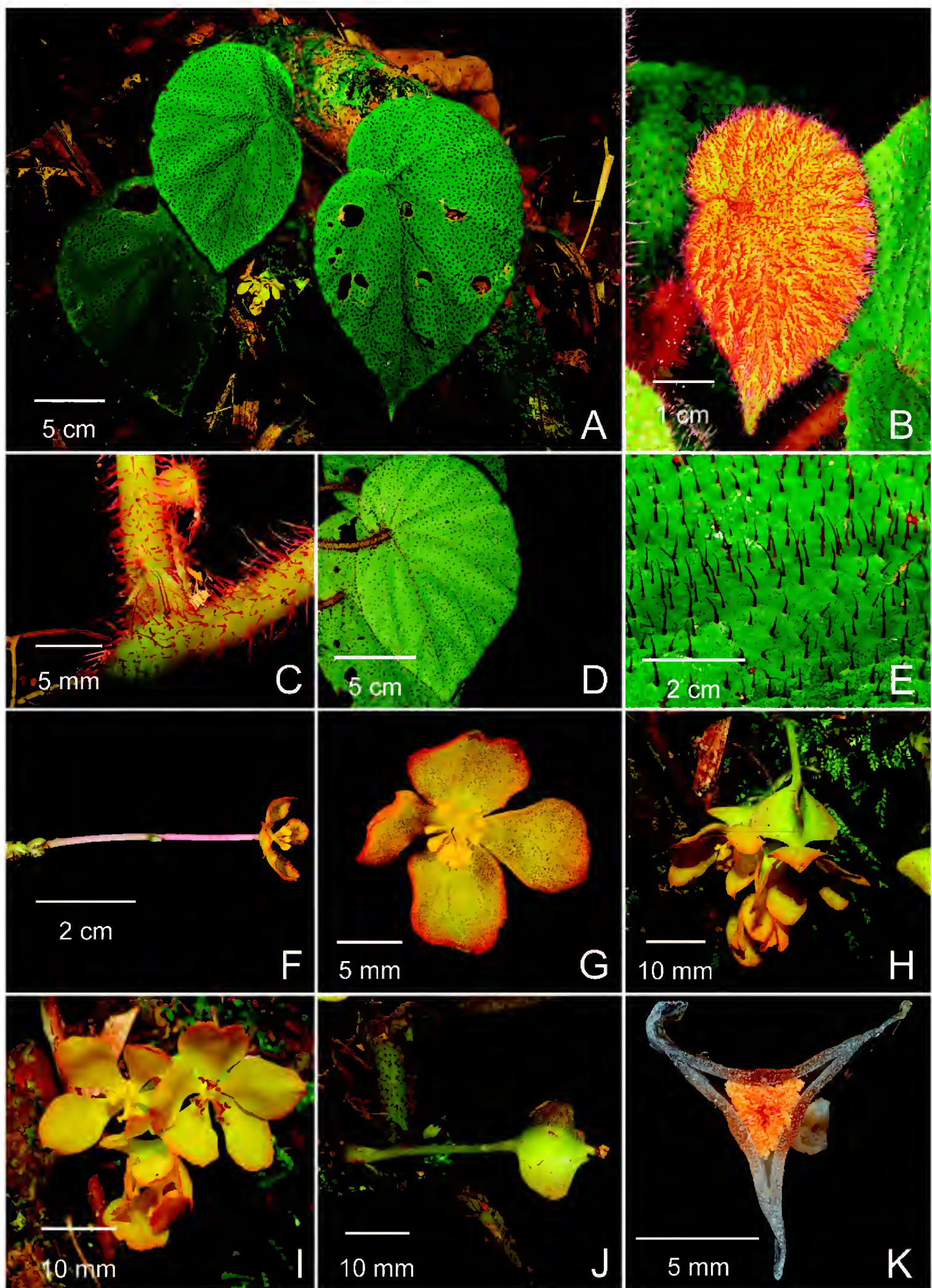
*Distribution*. Borneo. Endemic in Sarawak. So far known only from the type locality.

*Habitat*. Disturbed lowland mixed dipterocarp forest at 335 m elevation, near a cliff, on sandstone boulders.

*Conservation status*. Critically Endangered (CR B2ab(iii)). The species is known only from a single locality that lies outside the network of Totally Protected Areas and the habitat is threatened by logging activities that open up the canopy and cause siltation.

#### 4. *Begonia rubrotepala* S. Julia, sp. nov.

This species is unique among Bornean begonias for its 10–45 cm long, slender inflorescences that trail on the ground with only the apical portion erect, compared with others where the inflorescences are axillary on erect stems. Among the ‘calcareo group’, its inflorescence is different in that the same peduncle produces a single basal female flower followed by male flower(s) whereas in the other species male and female flowers are produced on separate inflorescences. In its petiole as long or longer than the lamina and its lamina more or less glabrous and broader than long with a well-developed basal lobe, it most resembles *B. sadirensis*, but its leaves are smaller



**Fig. 4.** *Begonia lingiae* S.Julia & Kiew. **A.** Habit. **B.** Young leaf. **C.** Stipule. **D.** Under surface of leaf. **E.** Close-up of upper leaf surface. **F, G.** Male flower. **H, I.** Female inflorescence. **J.** Fruit. **K.** Cross-section of ovary. From the type *SFC6161*. (Photos: C.Y. Ling)

8.5–13 × 8.5–16.5 cm with the basal lobe 1–3.5 cm long (vs. 13–17.5 × 13.3–19 cm with basal lobe 3.5–5 cm in *B. sadirensis*), its bracts are larger 15–22 × 6–8 mm (vs. 5–7 × 3 mm), its flowers are bright red (not deep orangey red), the pedicel of the male flower is short 6 mm long (vs. 5–22 mm), the outer tepal pair larger 11–12 × 9–10 mm (vs. 5–8 × 4–7 mm), stamens many 32–47 (vs. 23–27) and the capsule smaller 8–9 × 11–12 mm (vs. 12–15 × 15–17 mm) with a longer stalk 6–7 mm (vs. 2.5–4.5 mm). – TYPE: Borneo, Sarawak, Lubok Antu District, Ulu Engkari, Lanjak Entimau Wildlife Sanctuary, Sungai Segerak, 12 March 2016, *Julia et al.* SFC3453 (holotype SAR!; isotypes KEP!, SING!). (Fig. 5).

Creeping herb 25–45 cm long, rhizome and petiole covered with short soft white hairs (hairs reddish on young stem and petiole). **Rhizomes** dull brown, 8–10 mm thick, internodes (2.5–)5.5–10 cm long, unbranched, very succulent, slightly thicker at nodes. **Stipules** red-brown, ovate, 20–22 × 10–12 mm, margin entire, keeled, apex acuminate, seta to 5 mm long, caducous. **Leaves** alternate, 5–6 leaves per plant, distant, oblique, held horizontally; petioles dull dark brown, (10–)15–25 cm long, c. 6 mm diameter, terete, pilose, hairs brownish; lamina plain, dark green above, pale green beneath, young leaves olive green above, greenish beneath, in life succulent, matt, hirsute above, hairs short, stiff and dark brown, asymmetric, broadly ovate or almost rounded, (8.5–)10.5–13 × (8.5–)13–16.5 cm, broad side (5.5–)7.5–9.5 cm wide, base cordate, overlapping, basal lobes 1–3.5 cm wide, margin minutely serrate, apex acute; venation palmate, veins greenish above except near the leaf base, brownish or reddish beneath, veins 4 on either side of the midrib, 2 veins in basal lobe, prominent above, strongly prominent beneath; tertiary veins very conspicuous beneath, reticulate. **Inflorescences** protogynous, axillary opposite the leaf, 2–3 inflorescences per rhizome, horizontal on the ground, racemose, 10–45 cm long, red-brown. **Bracts** ovate, red brown, densely pilose, hairs reddish, keeled, 15–20 × 6–8 mm, apex setose, seta 2 mm long; bracteoles reddish brown, lanceolate or elliptic, lower bracteoles c. 10 × 6 mm, upper bracteoles c. 6 × 6 mm, margin toothed. **Male flowers:** pedicel red, c. 6 mm long, glabrous; tepals 4, anisomorphic, outer 2 tepals deep red outside, pinkish inside, outside covered with dense red hairs, inside glabrous, rounded, 11–12 × 9–10 mm, margin entire, apex rounded, inner 2 tepals whitish tinged red, glabrous, lanceolate, c. 8 × 4 mm, margin entire, apex acute; stamens 32–47, cluster globose, sessile, filaments pale to lemon yellow, c. 1 mm long, anthers pale to lemon yellow, obovate, c. 1 × 0.5 mm, apex emarginate. **Female flowers:** pedicel red, 7–10 mm long; tepals 5, rarely 6, outer 3–4 tepals broadly elliptic, 10–11 × 5–7 mm, bright red outside, reddish or whitish inside, margin entire, apex broadly acute, inner 2 tepals smaller, narrowly elliptic, 9–10 × 3 mm, pinkish; ovary bright red, covered with white or red hairs to 2 mm long, c. 10 × 13–16 mm, wings 3, equal, 5–6 mm wide, locules 3, placentas 2 per locule; styles 3, lemon yellow, c. 2 mm long; stigma yellow, widely Y-shaped, papillose forming a continuous twisted band. **Capsules** 8–9 × 11–12 mm, locules 3, wings 3, equal, rounded proximally and distally, 4–6 mm wide, dehiscent between the locules and wings; peduncle in fruit 8–19 cm long, not pendent; pedicel in fruit thread-like, 6–7 mm long.



**Fig. 5.** *Begonia rubrotepala* S.Julia. **A.** Habit. **B.** Stipule. **C.** Young leaf. **D, E.** Inflorescence. **F.** Male flower. **G, H.** Female flower. **I.** Cross section of ovary. From type *SFC3453*. (Photos: S. Julia)

*Etymology.* From the tepal colour (Latin, *rubro* = red; *tepala* = tepal).

*Distribution.* Borneo. Endemic in Sarawak, known from Lubok Antu District (Batang Ai National Park), Song District (Lanjak Entimau Wildlife Sanctuary) and the Belaga District.

*Habitat.* Riparian forest, on steep or gentle slopes less than 5 m from the water's edge, on clayey soils.

*Conservation status.* Least Concern. The species is commonly seen in Totally Protected Areas (Batang Ai National Park and Lanjak Entimau Wildlife Sanctuary).

*Notes.* This is a striking species in its bright red flowers. The only other begonia in this group with red flowers is the Bintulu population of *Begonia calcarea*. Its 10–45 cm-long, slender inflorescences are unique among Bornean begonias in that they trail on the ground with only the apical portion erect. On the same inflorescence they produce a single female flower followed by male flowers compared with other species in the 'calcarea group' where male and female flowers are produced on separate inflorescences. In addition, the bracts are large and more prominent. It is also the only species in the 'calcarea group' that does not have male flowers with isomorphic tepals.

*Additional specimens examined.* MALAYSIA: **Sarawak:** Lubok Antu District, Batang Ai National Park, Sungai Bebilong Besai, 2 Aug 2015, *Julia et al.* SFC2756 (SAR!); Lubok Antu District, Batang Ai National Park, Sungai Bukoh, 17 Mar 2016, *Julia et al.* SFC3485 (SAR!); Lubok Antu District, Batang Ai National Park, Sg. Kenaban, 18 Mar 2016, *Julia et al.* SFC6623 (SAR!); Lanjak Entimau PF, Sg. Jelok, near Bukit Sengkajang, 18 Mar 1974, *Chai S34013* (SAR!); Song District, Ulu Katibas, Lanjak Entimau Wildlife Sanctuary, on ridge going west up across Sg. Menyarin towards Ulu Menyarin, close to Camp A, base of ridge running SW, 21 Nov 1997, *Pearce et al.* ITTO/BB0732 (SAR!); Belaga District, up River ex Punan Busang, 18 Jun 1971, *Goh & Samsuri GSY703* (SAR!).

**5. *Begonia sabahensis*** Kiew & J.H.Tan, Gard. Bull. Singapore 56: 73 (2004); Kiew et al., Guide to Begonias of Borneo 244 (2015). – TYPE: Sabah, Tenom District, Sungai Telekosen, 11 February 2004, *Recin Sapau & Tan, J.H. AL727/2004* (holotype SAN!). (Fig. 6)

*Distribution.* The species is known only from the type locality.

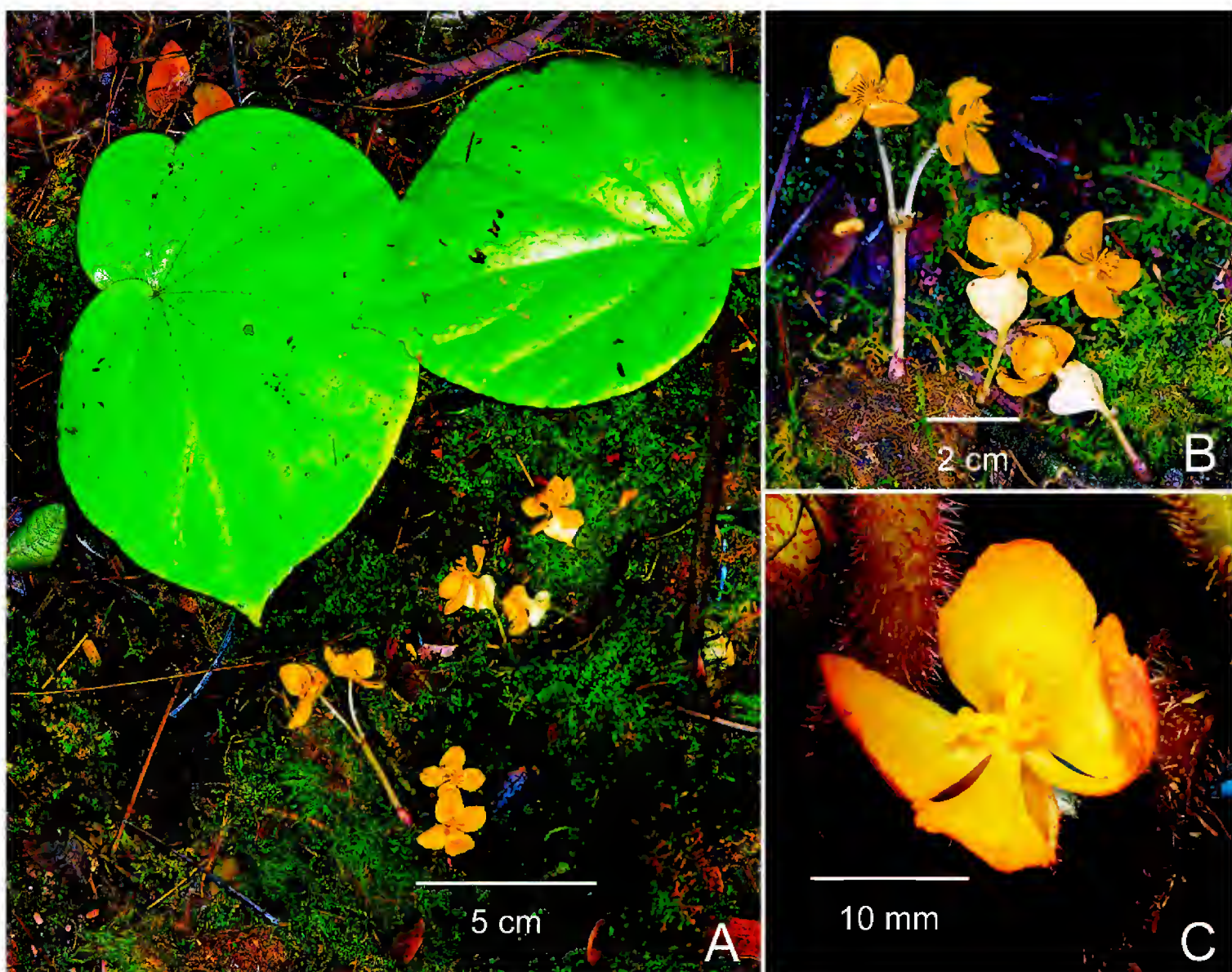
*Habitat.* In transition forest between hill and lower montane forests on steep shaded slopes.

*Conservation status.* Critically Endangered (CR B2ab(iii)). It is extremely rare with a small population that is outside the network of Totally Protected Areas and currently in danger of habitat disturbance from logging activities.

**6. *Begonia sadirensis*** Kiew & S.Julia, **sp. nov.**

Similar to *Begonia sabahensis* Kiew & J.H.Tan in its stout petiole that is as long or longer than the lamina, its lamina broader than long, and lamina more or less glabrous above, but it is different from *B. sabahensis* in having larger laminas, 13–17.5 × 13.5–





**Fig. 6.** *Begonia sabahensis* Kiew & J.H.Tan. **A.** Habit and inflorescence. **B.** Male and female inflorescence. **C.** Female flower. All photos reproduced with permission from Kiew et al., 2015.

19 cm (vs. laminae c. 10 × 12 cm), longer petioles (12–)17.5–32.5 cm (vs. petioles 8–17 cm) and orangey red flowers (vs. flowers yellow). – TYPE: Borneo, Sarawak, Padawan District, Kampung Sadir, 11 July 2015, *Julia et al.* SFC6173 (holotype SAR!). (Fig. 7).

Creeping herb to 30 cm long, rhizome prostrate, rooting at nodes. Rhizomes, stipules, petioles and both surfaces of veins hispid with appressed hairs, more noticeable on petioles and young shoots. **Rhizomes** red-brown, unbranched, succulent, 6–11 mm thick, internodes 2–4 cm long, slightly thickened at nodes. **Stipules** red-brown, broadly lanceolate, 14–24 × 7–15 mm, keeled, densely shortly hispid, margin entire, apex acute, persistent. **Leaves** alternate, distant, oblique, held horizontally; petioles stout, red-brown, (12–)17.5–32.5 cm long, appressed hispid, grooved above; lamina plain green, paler beneath, in life succulent, glabrous with the occasional hairs above, glossy, asymmetric, ovate, 13–17.5 × 13.3–19 cm, broad side 8.3–11.2 cm wide, base deeply cordate and overlapping, basal lobes 3.5–5 cm long, margin minutely toothed, teeth tipped by a hair, apex acuminate, acumen c. 2 cm long; venation palmate-pinnate, 2 pairs at the base, 2–3 veins on either side of the midrib, 2–3 veins in basal lobe,

veins plane above, prominent and ferruginous below. *Plant* protogynous. *Male inflorescences* from upper leaf axils, slender, 1.5–4.5 cm long, a cyme 3–6 cm long; peduncle 2.2–3.2 cm long. *Bracts* several congested at base, reddish to pinkish, narrowly lanceolate, 5–7 × 3 mm, margin entire, glabrous, persistent; bracteoles ovate, c. 3 × 2 mm, glabrous, margin entire, caducous. *Female inflorescence* (young) from lower leaf axil, a compound cyme to 2 cm long. *Bracts* red to pale pink, lanceolate to oblanceolate, c. 6 × 2 mm, margin entire, apex setose, seta to 1 mm long, persistent; bracteoles pinkish, lanceolate, c. 5 × 2 mm, margin entire, apex setose, seta to 1 mm long, persistent. *Male flowers*: pedicel pinkish, (5–)10–22 mm long, glabrous; tepals 4, orangey red, glabrous, broadly ovate, 5–8 × 4–7 mm, margin entire, apex rounded; stamens 23–27, cluster globose, sessile, filaments pale yellow, 2–2.5 mm long, anthers lemon yellow, obovate, 1–1.5 × 0.5 mm, apex emarginate. *Female flowers*: pedicel pale pink, c. 3 mm long, glabrous; tepals 5, orangey red, glabrous, elliptic, 8–9 × 4–5 mm, margin entire, apex broadly acute; ovary deep pink particularly the wings, pale pink at centre, ovoid, c. 12 × 18 mm, glabrous, wings 3, equal, locules 3, placentas 2 per locule; styles 3, lemon yellow, c. 3 mm long, divided to base, widely anchor-shaped; stigma yellow-orange, papillose forming a continuous twisted band. *Capsules* 1–5 from the lower leaf axil, whitish or pale red, 12–15 × 15–17 mm, glabrous, locules 3, wings 3, unequal, broadly acute proximally and distally, 4–7 mm wide, thinly fibrous, dehiscent between locule and wing; peduncle in fruit 2.5–5 cm long, slightly pendent; pedicel in fruit pendent, 2.5–4.5 mm long.

*Etymology*. Named after the type locality.

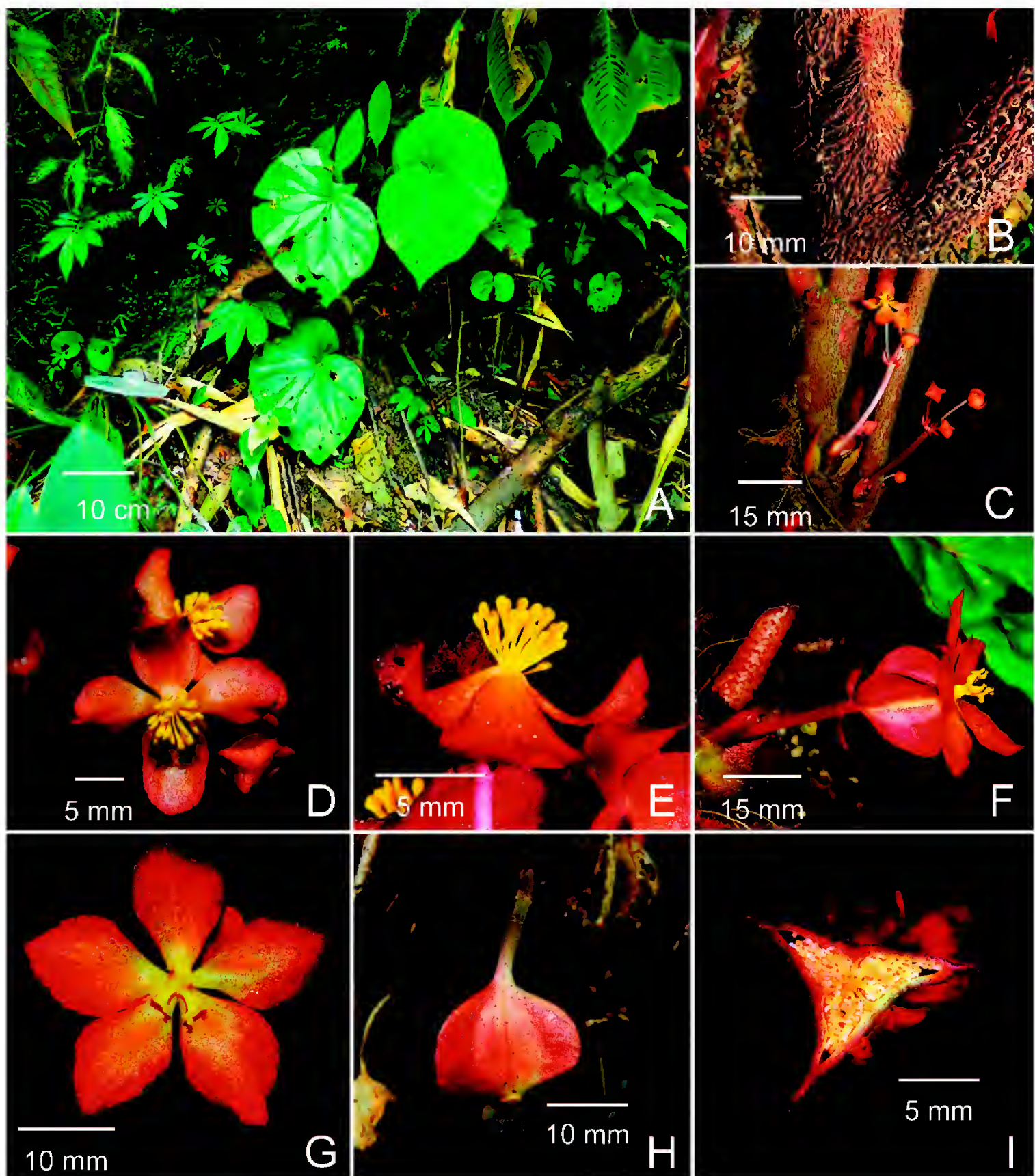
*Distribution*. Borneo. Endemic in Sarawak. Known only from the type locality.

*Habitat*. A disturbed seasonal creek, near sandstone boulders or rock faces along a small stream.

*Conservation status*. Critically Endangered (CR B2ab(iii)). The species is known only from a single locality outside the network of Totally Protected Areas. The habitat is threatened due to local disturbance.

## Discussion

The large genus *Begonia*, which is among the ten largest genera of vascular plants (Frodin, 2004), has more than 1825 species worldwide (Hughes et al., 2015). The most recent comprehensive sectional classification of the genus is that by Doorenbos et al. (1998). The sections that include Bornean species are *Begonia* sect. *Diploclinium* (Lindl.) A.DC., *Begonia* sect. *Petermannia* (Klotzsch) A.DC., *Begonia* sect. *Reichenheimia* (Klotzsch) A.DC. and *Begonia* sect. *Sphenanthera* (Hassk.) Warb. Recently a further section, *Begonia* sect. *Baryandra* A.DC., was redefined and now includes a few Bornean species that were previously included in *Begonia* sect.



**Fig. 7.** *Begonia sadirensis* Kiew & S. Julia. **A.** Habit. **B.** Stipule. **C.** Male inflorescence. **D, E.** Male flowers. **F, G.** Female flower. **H.** Fruit. **I.** Cross-section of ovary. From the type *SFC6173*. (Photos: C.Y. Ling)

*Diploclinium* (Rubite et al., 2013). Doorenbos et al. (1998) doubtfully placed *Begonia calcarea* in *Begonia* sect. *Diploclinium* Group I on account of it possessing rhizomes, an ovary with three locules and bilamellate placentas, and dry capsules. Group II of *Begonia* sect. *Diploclinium* included species from continental Asia, many of which were tuberous. Based on morphology, *Begonia* sect. *Diploclinium* was clearly a problematic group being heterogeneous and polymorphic.

Thomas et al. (2011) noted that *Begonia* sect. *Diploclinium* had become a dustbin and that phylogenetic analyses clearly demonstrated that *Begonia* sect. *Diploclinium* was polyphyletic. In their analysis, *Begonia* sect. *Diploclinium* included two distinct clades: the continental Asian species with tubers (part of their Clade C) and the rhizomatous Malesian species (Clade D). The type species for *Begonia* sect. *Diploclinium*, *Begonia grandis* Otto ex A.DC, belongs to the tuberous group, which formed a basal grade in the analyses of Thomas et al. (2011) in a clade also comprising species of *Begonia* sect. *Sphenanthera* and *Begonia* sect. *Platycentrum*. Sectional delimitation within this group needs to be revised.

Rubite et al. (2013) examined the rhizomatous Malesian *Begonia* sect. *Diploclinium* group, which has a centre of diversity in the Philippines, in detail and concluded that they were distinct from continental species of *Begonia* sect. *Diploclinium*. They expanded and redefined *Begonia* sect. *Baryandra* to accommodate these species. While the majority of species in this section are from the Philippines (40 species), a few occur in Borneo (5 species) and New Guinea (7 species). Of the remaining Bornean rhizomatous species from *Begonia* sect. *Diploclinium*, they note that *B. calcarea* and *B. sabahensis* have no affinity with *Begonia* sect. *Baryandra* but that it was not clear to which section they belong.

On morphological grounds (see Introduction) the ‘*calcarea* group’ of species is clearly distinct from the other sections occurring in Borneo. However, until its species are included in phylogenetic analyses (material will be DNA sequenced in the near future) and molecular data used to shed some insight into whether they form a monophyletic group that is distinct from the other sections, it is premature to erect a new section to accommodate them.

Apart from *Begonia calcarea*, the other species in the ‘*calcarea* group’ are to date known only from one or two localities (Fig. 1). In addition, they all occur as small populations, which make them particularly vulnerable to habitat disturbance. Of these narrowly distributed species, only *Begonia rubrotepala* lies within the network of Totally Protected Areas (i.e., within the Batang Ai National Park and Lanjak Entimau Wildlife Sanctuary) whereas the other species (*B. kanaensis*, *B. lingiae*, *B. sabahensis* and *B. sadirensis*) occur outside Totally Protected Areas. *Begonia lingiae*, *B. sabahensis* and *B. sadirensis* are threatened by habitat disturbance from logging activities or local disturbance and therefore fall within the Critically Endangered category while *B. kanaensis* is considered Endangered. *Begonia calcarea* is also considered Least Concern as the localities are widespread and include a Totally Protected Area (Lanjak Entimau Wildlife Sanctuary).

**ACKNOWLEDGEMENTS.** We gratefully acknowledge financial assistance from the Sarawak Forestry Corporation for the field work. We are sincerely grateful to the management team of Sarawak Forestry Corporation, particularly the Chief Executive Officer, Wong Ting Chung and the Deputy General Manager, Julaihi Lai Abdullah, for their continuous support of botanical research in Sarawak. We thank our colleagues from the Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park and from AFSID staff, Vilma Bodos, Paul Sawai, Tinjan Kuda, Jaies Chankul, Sirukit Dubod and Shalih Rebi, for their valuable assistance during the field work, the Curator of Sarawak Herbarium, Hajjah Mohizah Mohamad, and the Keeper of the Royal

Botanic Gardens Kew Herbarium for allowing us access to herbarium specimens in their care, to Daniel C. Thomas for his helpful comments, to Datuk Chan Chew Lun of Natural History Publications (Borneo) and Anthony Lamb for permission to reproduce the images of *Begonia sabahensis*; and Zedtee Sdn. Bhd. for providing logistic assistance to the third author during the field trip to Bukit Kana and Anap Muput in 2015.

## References

- Doorenbos, J., Sosef, M.S.M & De Wilde J.J.F.E. (1998). The sections of *Begonia* including descriptions, keys and species lists (Studies in Begoniaceae VI). *Wageningen Agric. Univ. Pap.* 98(2):1–266.
- Frodin, D.G. (2004). History and concepts of big plant genera. *Taxon* 53:753–776.
- Hughes, M., Moonlight, P., Jara, A. & Pullen, M. (2015). *Begonia* Resource Centre. Royal Botanic Garden Edinburgh. <http://elmer.rbge.org.uk/begonia/> (accessed on 8 May 2016)
- Kiew, R. & Tan, J.H. (2014). *Begonia sabahensis* Kiew & J.H. Tan (Begoniaceae), a new yellow-flowered *Begonia* from Borneo. *Gard. Bull. Singapore* 56:73–77.
- Kiew, R., Julia, S., Rimi, R. & Joffre, A.A. (2015). *A Guide to Begonias of Borneo*. 293 pp. Kota Kinabalu: Natural History Publications (Borneo).
- Ridley, H.N. (1906). Begonias of Borneo. *J. Straits Branch Roy. Asiat. Soc.* 46: 260.
- Rubite, R.R., Hughes, M., Alejandro, G.J.D. & Peng, C.-I. (2013). Recircumscription of *Begonia* section *Baryandra* (Begoniaceae) evidence from molecular data. *Bot. Stud.* 54: 38–42.
- Thomas, D.C., Hughes, M., Phutthai, T., Rajbjandary, S., Rubite, R.R., Ardi, W.H. & Richardson, J.E. (2011). A non-coding plastid DNA phylogeny of Asian *Begonia* (Begoniaceae): Evidence for morphological homoplasy and sectional polyphyly. *Molec. Phylogenet. Evol.* 60: 428–444.



## Eight new *Begonia* (Begoniaceae) species from the Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park, Sarawak, Borneo

S. Julia<sup>1</sup> & R. Kiew<sup>2</sup>

<sup>1</sup>Botanical Research Centre, Sarawak Forestry Corporation,  
Kuching, Sarawak, Malaysia  
juliasang@sarawakforestry.com

<sup>2</sup>Forest Research Institute Malaysia, Kepong 52109,  
Selangor, Malaysia  
ruth@frim.gov.my

**ABSTRACT.** Eight new *Begonia* (Begoniaceae) species, *Begonia adrinii* S.Julia & Kiew, *Begonia celata* S.Julia & Kiew, *Begonia crassa* S.Julia & Kiew, *Begonia devexa* S.Julia & Kiew, *Begonia fractiflexa* S.Julia & Kiew, *Begonia hirtitepala* S.Julia & Kiew, *Begonia jambilahanuiana* S.Julia and *Begonia ubahribuensis* S.Julia & Kiew, are described from Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park in Sarawak, Malaysia. Two and four species are only known from Batang Ai National Park and Lanjak Entimau Wildlife Sanctuary respectively while two species are found in both sites. Seven species belong to *Begonia* sect. *Petermannia* and the placement of one (*Begonia fractiflexa*) is uncertain.

**Keywords.** *Begonia*, RIMBA, Sarawak, Totally Protected Area

### Introduction

In August 2015, the State Government of Sarawak launched the RIMBA SARAWAK (Research for Intensified Management of Bio-Rich Areas) project focusing on research in three of its Totally Protected Areas, i.e., Lanjak Entimau Wildlife Sanctuary (WS), Batang Ai National Park (NP) and Sebuyau National Park. This on-going RIMBA SARAWAK project was initiated through the Sarawak Forestry Corporation to provide a platform for research collaboration with international, regional and local researchers on biodiversity and forests in these bio-rich areas.

Lanjak Entimau WS (111°53'E to 112°28.5'E and 1°19'N to 1°51'N) covers approximately 192,000 ha of forest on rugged hilly topography in south western Sarawak. It was gazetted as a wildlife sanctuary in 1983 and its area extended in 2003 (Chai, 2011). It lies in four administrative districts, Lubok Antu District in the southern part, Julau and Sibu Districts in the northern part and Song District in the eastern part. In 1994, Lanjak Entimau WS became part of the Trans-boundary Biodiversity Conservation Area with Betung Kerihun National Park in Kalimantan, Indonesia, under a project supported by the International Tropical Timber Organisation (ITTO). As a sanctuary for the protection of wildlife and their habitats, under the National

Parks Ordinance, 1998, access to Lanjak Entimau WS is restricted to scientists and researchers with permits. Batang Ai NP, which is contiguous with the southern part of Lanjak Entimau WS, was gazetted as a Totally Protected Area in 1991 and, including a later extension, covers an area of 32,100 ha.

Recent field work focusing on begonias by the first author in two of the RIMBA SARAWAK's sites, Lanjak Entimau WS and Batang Ai NP, resulted in the collection and re-collection of materials used to describe eight new species in this paper. Of these eight species, five species were collected for the first time while three species had previously been collected but were not described. Meekiong et al. (2010) noted that 12 species were recorded from Lanjak Entimau WS including the newly described *Begonia kurakura* Tawan, Ipor & Meekiong (2009). In Batang Ai NP, nine species have been described (Lin et al., 2014; Julia & Kiew, 2016).

Seven new species described in this paper belong to *Begonia* sect. *Petermannia* and one (*Begonia fractiflexa*) is of uncertain placement. Of these eight species, two species (*B. hirtitepala* and *B. jambilahanuiana*) occur in both Lanjak Entimau WS and Batang Ai NP while four species are presently known only in Lanjak Entimau WS (*B. crassa*, *B. fractiflexa*, *B. devexa* and *B. ubahribuensis*) and two species (*B. addrinii* and *B. celata*) are known only from Batang Ai NP. As indicated by the discovery of new species, particularly from Batang Ai NP, more new species can be expected once more areas within these Totally Protected Areas are explored.

Although all species have narrow distribution ranges and only occur in one or few localities, all species are considered Least Concern (IUCN, 2012). Their habitats are well and legally protected within the Totally Protected Areas. The species are also commonly seen where they occur with populations comprising individuals in various life stages, including reproductive plants.

## Methodology

Materials used for the description of species are based mainly on specimens collected by the first author and her colleagues during field trips in March 2016 and May 2016, as well as the existing specimens available in the Sarawak Herbarium (SAR). All measurements are from freshly collected materials unless indicated otherwise. The diagnostic characters of all new species in this paper were compared with the characters of similar species based on the descriptions in their protologues unless indicated otherwise.

## Taxonomy treatment

### 1. *Begonia addrinii* S. Julia & Kiew, sp. nov. (Section *Petermannia*)

In its creeping habit and small obovate leaves, it is similar to *Begonia crockerensis* Rimi but it is different in its shorter internodes, 1.4–2 cm long (vs. 2.3–2.6 cm long), smaller stipule, 3–10 × 2–5 mm (vs. 14–23 × 5–7 mm), leaves usually growing flat against boulders (vs. upstanding or semi-erect), leaf base cordate with a relatively large



basal lobe, 0.3–0.7 cm long (vs. leaf base rounded with smaller basal lobe, c. 0.2 mm long), laminas that are always plain green and pilose above (vs. glabrous leaves with two colour forms, green or dark bronze-green), inflorescence in a 3-flowered cyme (vs. a thryse), and 25–30 stamens (vs. c. 17). – TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Batang Ai NP, Sungai Buban, 1°17'44"N 112°04'03"E, 153 m, 19 March 2016, *Julia et al.* SFC6653 (holotype SAR!; isotypes KEP!, SING!, SNP!). (Fig. 1)

Creeping herb, rooting at the nodes; stem, leaves and petiole pilose, hairs reddish to whitish. **Stems** to 15 cm long, unbranched, green, pilose, hairs brownish or reddish, c. 3 mm thick; internodes 1.4–2 cm long, slightly swollen at nodes. **Stipules** pale green, acute, 3–10 × 2–5 mm, margin entire, apex acute, caducous. **Leaves** closely arranged, flattened onto boulders, not oblique; petioles pale green, 1.1–2.2 cm long, succulent, terete; lamina plain green above, paler beneath, in life succulent, drying papery, slightly asymmetric, obovate or sometimes orbicular, 2.3–5 × 2.1–5 cm, base cordate, basal lobe 0.3–0.7 cm long, margin serrate, apex rounded; venation palmate, branching twice towards the margin, concolorous, slightly impressed above, prominent beneath. **Inflorescences** erect, axillary along the creeping stem, red-brown or greenish, unbranched, 4.5–10 cm long, topped by a cyme of 1 female and 2 male flowers. **Bracts** reddish or pale green, lanceolate, 4–7 × 2–3 mm, margin entire, keeled, apex acute, persistent; bracteoles greenish or reddish, ovate to lanceolate, 2–3 × 1–1.5 mm, margin entire. **Male flowers** with white pedicels, 5–17 mm long; tepals 4, white, margin entire, apex broadly acute, outer 2 tepals elliptic, 6–12 × 4–7 mm, inner 2 tepals narrowly elliptic, 6–8 × 1.5–4 mm; stamens 25–30, cluster loosely globose, sessile, filaments c. 1.2 mm long, anthers lemon yellow, obovate, c. 1 × 0.4 mm, apex emarginate. **Female flowers** with whitish or greenish pedicels, 6–8 mm long; tepals 5, white, pinkish or whitish green, broadly ovate, outer 4 tepals 4–12 × 4–5 mm, inner tepal 5–6 × 3 mm, margin entire, apex broadly acute; ovary white, pinkish or greenish tinged reddish, 5–7 × 6–9 mm, wings 3, unequal, 2–5 mm wide, locules 3, placentas 2 per locule; styles 3, lemon yellow, 2–3 mm long; stigma lemon yellow, anchor-shaped, papillose. **Capsules** single, pale green, 5–7 × 12 mm, locules 3, wings 3, unequal, 3–4 mm wide, acute proximally and distally, dehiscing between the locules and wings; pedicel in fruit pendent, green, stiff, 4–8 mm long.

*Etymology.* Named for Addrin anak Kemarau, the Park Ranger at Batang Ai National Park who first discovered this new species.

*Distribution.* Endemic in Sarawak, as yet known only from the Batang Ai NP.

*Habitat.* Riparian forest at 153 m elevation, growing on a thin soil layer on sandstone boulders in shaded area.

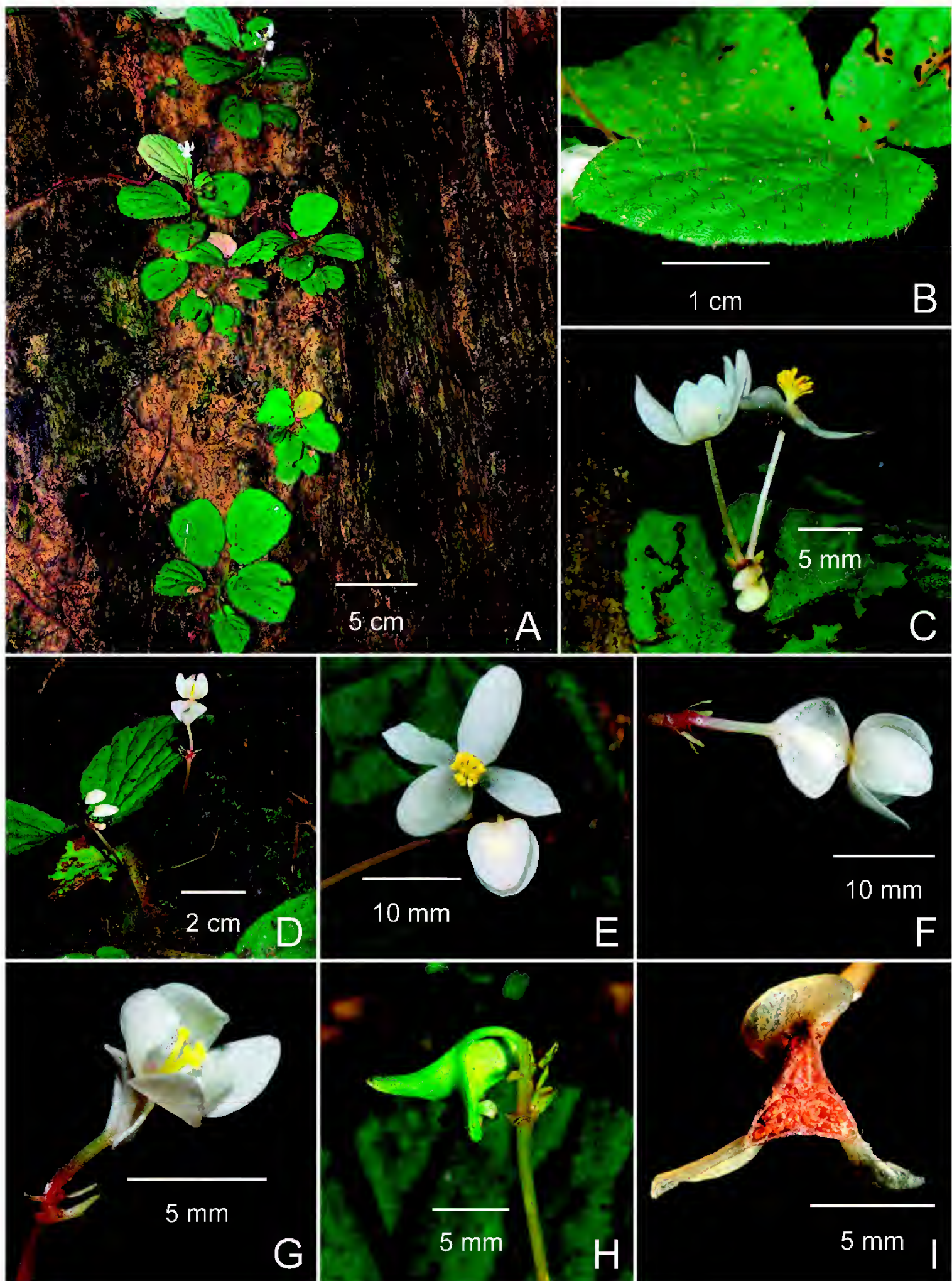
*Notes.* Among begonias that grow in the Batang Ai NP (Julia & Kiew, 2016), this pretty creeping begonia shares a similar habit and small leaf size with *Begonia tebiang* S. Julia & Kiew, but this latter species is different in its ovate leaves, 5.5–10.5 × 4.5–8.5 cm, and its thryse with persistent and larger bracts, 7–17 × 4–11 mm.

**2. *Begonia celata* S. Julia & Kiew, sp. nov.** (Section *Petermannia*)

In its small creeping habit, small hairy, broadly ovate leaves it is similar to *Begonia baik* C.W. Lin & C.-I. Peng but it is different in its smaller, lanceolate stipules  $7\text{--}12 \times 2.5$  mm (vs. ovate and  $17\text{--}20 \times 8$  mm), longer and grooved petiole 3.3–6 cm long (vs. 1.5–2.5 cm long in upper leaves, to 7.5 cm in lower leaves), and its shorter and broader capsules  $6\text{--}7 \times 10\text{--}11$  mm (vs. c.  $9 \times 6$  mm). – TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Batang Ai NP, Sungai Bebiyong Mit,  $1^{\circ}18'01''\text{N } 112^{\circ}04'24''\text{E}$ , 163 m, 19 March 2016, *Julia et al. SFC6661* (holotype SAR!; isotypes KEP!, SING!, SNP!). (Fig. 2)

Herb to 5–30 cm tall, stem and leaves pilose, hairs purplish. **Stems** sparsely branched, green, 4–5 mm thick; internodes 0.7–2 cm long, slightly swollen at nodes. **Stipules** pale green, lanceolate,  $7\text{--}12 \times 2\text{--}5$  mm, keeled, margin entire, apex setose, seta to c. 1 mm long, persistent. **Leaves** sometimes flattened against the steep earth bank, oblique; petioles reddish brown, 3.3–6 cm long, slightly grooved; lamina plain green to coppery green above, deep red-brown beneath, in life slightly succulent, drying papery, asymmetric, broadly ovate to orbicular,  $6\text{--}7.5 \times 5.5\text{--}8.5$  cm, broad side 3.6–5.4 cm, base unequal, cordate, sometimes overlapping, basal lobe 0.7–1.5 cm long, margin dentate, apex acute; venation palmate-pinnate, 3–4 veins on each side, 2–4 veins on basal lobe, branching twice towards the margin, impressed above, prominent beneath. Inflorescences erect, axillary on the upper leaf axil, dichasium 4.5–9 cm long, red-brown with reddish hairs, peduncle 2.3–5 cm long. **Bracts** pale green, ovate,  $6\text{--}11 \times 3\text{--}5$  mm, keeled, margin ciliate, apex acuminate, acumen to 1 mm long, persistent; bracteoles up to 12 pairs per partial inflorescence, lower bracteoles ovate, pale green,  $8\text{--}9 \times 4$  mm, slightly keeled, margin ciliate, apex setose, seta to 1 mm long, upper bracteoles reddish or pinkish, ovate,  $4\text{--}5 \times 2\text{--}3$  mm, margin ciliate, persistent; margin toothed, teeth tipped by a hair. **Male flowers** with white or reddish pedicels, 6–10 mm long; tepals 4, completely white or pinkish outside, white inside, sprinkled with white hairs outside, glabrous inside, margin entire, apex broadly acute or rounded, outer 2 tepals broadly ovate,  $9\text{--}11 \times 6\text{--}9$  mm, inner 2 tepals oblanceolate,  $7\text{--}9 \times 2\text{--}3$  mm; stamens 28–35, cluster globose, subsessile, filaments c. 1 mm long, anthers lemon yellow, obovate, c.  $1 \times 0.5$  mm, apex emarginate. **Female flowers** with pale green hispid pedicels, 7–10 mm long; tepals 5–6, bright red, pinkish or white outside, white inside, hairy outside, glabrous inside, margin entire, apex rounded, outer 3–4 tepals obovate,  $7\text{--}10 \times 4\text{--}6$  mm, inner 2 tepals oblanceolate,  $8\text{--}9 \times 2\text{--}3$  mm; ovary bright red, pink or green with red wings,  $6\text{--}7 \times 8\text{--}9$  mm, covered with white hairs, hairs 2–3 mm long, wings 3, equal, 2–3 mm wide, locules 3, placentas 2 per locule; styles 3, lemon yellow, 2–3 mm long; stigma lemon yellow, anchor-shaped, papillose. **Capsules** (old) single or 2–3 capsules per infructescence,  $6\text{--}7 \times 10\text{--}11$  mm, locules 3, wings 3, equal, broadly acute proximally and acute distally, 2–3 cm wide, dehiscing between the locules and wings; pedicel in fruit pendent, glabrous, 8–12 mm long.

*Etymology.* Latin, *celatus* = hidden; referring to the habitat where it grows hidden below tree roots or rocky boulders.



**Fig. 1.** *Begonia adrinii* S.Julia & Kiew. **A.** Habit. **B.** Hairy upper leaf surface. **C.** Male inflorescence. **D.** Male and female inflorescences. **E.** Male flower. **F, G.** Female flower. **H.** Fruit. **I.** Cross-section of ovary. From the type *SFC6653*. (Photos: A–H, S. Julia; I, C.Y. Ling)

*Distribution.* Endemic in Sarawak, as yet known only from Batang Ai NP.

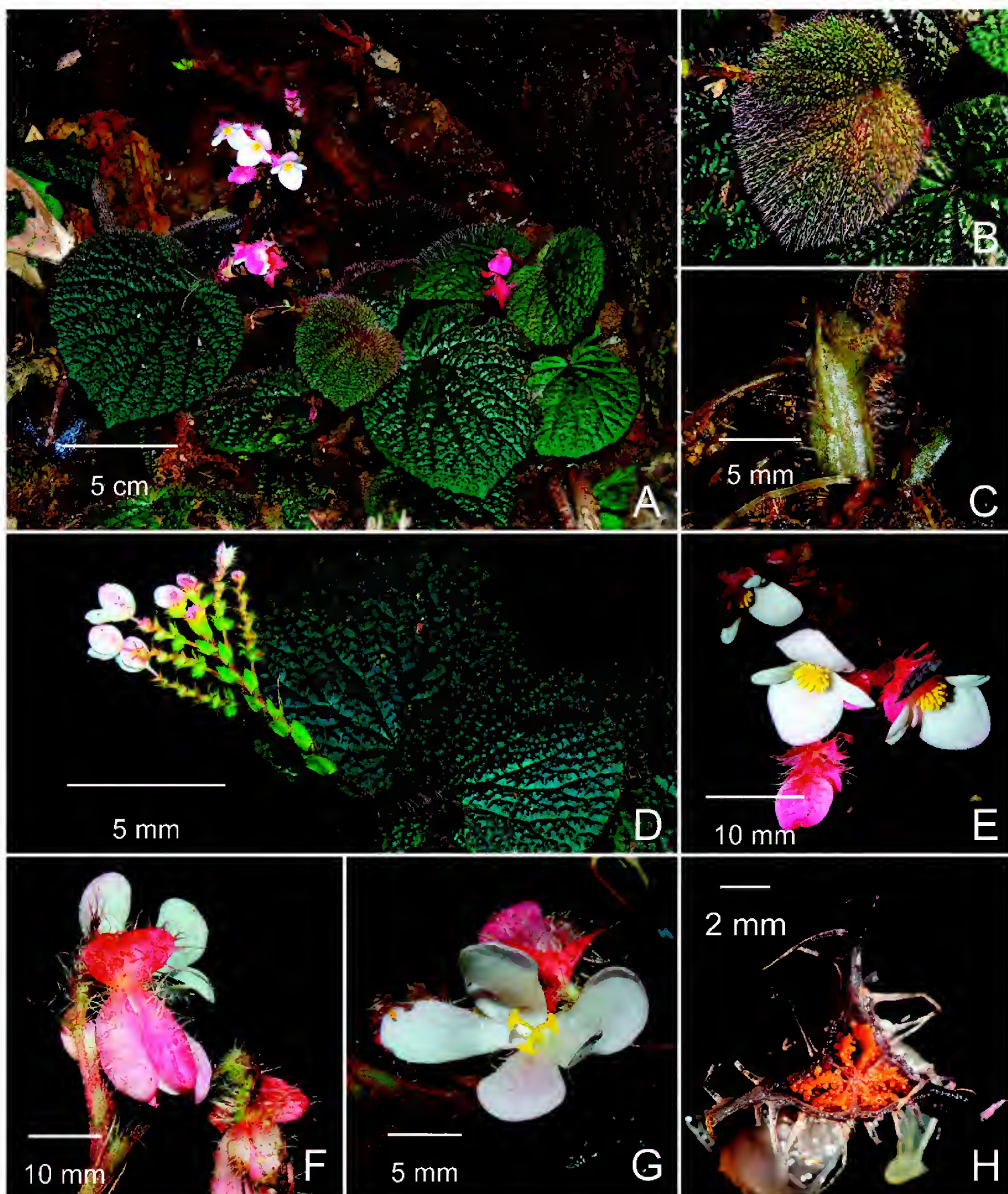
*Habitat.* Riparian forest below 200 m elevation, growing in shaded areas under rocky boulders, near tree buttresses or tree roots on a gentle slope.

*Notes.* Its habitat is unique in that it was only found growing below tree roots or boulders, perhaps indicating that it is intolerant of its leaves being soaked by rain or the soil being waterlogged. Among begonias in Batang Ai NP (Julia & Kiew, 2016), *Begonia celata* is close to *B. tebiang* in having small leaves, but *B. tebiang* has a creeping habit with longer internodes (2.5–8.5 cm long), a glabrous lamina, fewer bracteole pairs, glabrous female flowers with a shorter pedicel (c. 1 mm long) and a wider ovary (14–15 mm wide). *Begonia celata* is rather localised and only found in a few patches along the stream banks.

### 3. *Begonia crassa* S. Julia & Kiew, **sp. nov.** (Section *Petermannia*)

Similar to *Begonia conniegeriae* S. Julia & Kiew in its cane-like habit and dense clusters of many male flowers but it is different in its thick, succulent ridged stem, its lack of hairs, veins only slightly impressed above compared with *B. conniegeriae* that has a slightly woody terete stem, reddish brown indumentum and veins deeply impressed above. – TYPE: Malaysia, Borneo, Sarawak, Julau District, Ng. Biladayat, Ulu Sg. Sugai, Mujok, Lanjak Entimau WS, 1°44'03"N 112°05'52"E, 198 m, 3 March 2003, *Rantai et al. S 90832* (holotype SAR!; isotypes K!, KEP!). (Fig. 3)

Cane-like begonia. **Stems** to 70 cm tall, unbranched, glabrous, translucent, pale green, very succulent, 10–15 mm thick, ridged; internodes 4–9(–11) cm long, swollen at nodes. **Stipules** translucent green, tinged reddish, broadly lanceolate, 20–25 × 8 mm, reflexed, margin entire, apex sharply acute, persistent. **Leaves** distant, held more or less horizontally, oblique; petioles pale green, 1.2–3.5 cm long, 3–6 mm thick, succulent, ridged, grooved above; lamina plain green and glossy above, hirsute between the veins above, paler and glabrous beneath, in life succulent, drying papery, asymmetric, broadly ovate, 16–23 × 9–15 cm, broad side (4–)7–10.5 cm long, base cordate, unequal, basal lobe 2–2.5 cm long, margin dentate, apex acuminate, acumen 0.5–2 cm long; venation palmate-pinnate with 4–5 veins at the base and 2–3 veins on either side of the midrib, branching twice towards the margin, concolorous, slightly impressed above, prominent beneath; lower leaf smaller, ovate, c. 8.2 × 5.3 cm, broad side c. 3.5 cm long, base cordate, unequal, basal lobe 0.8–1 cm long. **Male inflorescences** axillary in upper leaf axils, a compact cluster of cymules, c. 3 cm long, peduncle c. 1.3 cm long, reddish green. **Bracts** reddish with greenish base or sometimes green with red edges, ovate, c. 20 × 15 mm, margin entire, apex acute, persistent; bracteoles red, orbicular, 10–14 × 10–14 mm, margin irregularly toothed, each pair of bracteoles enfolding cymules of 6–12 male flowers. **Male flowers** with white pedicels, 5–10 mm long; tepals 2, white, margin entire, apex broadly acute, oval, 6–7 × 4–5 mm, reflexed; stamens 31–35, cluster conical, sessile, filaments 0.6–0.8 mm long, anthers pale yellow, obovate, c.



**Fig. 2.** *Begonia celata* S.Julia & Kiew. **A.** Habit. **B.** Hairy upper leaf surface. **C.** Stipule. **D.** Inflorescences. **E.** Male flowers. **F & G.** Female flower. **H.** Cross-section of ovary. From the type *SFC6661*. (Photos: A–G, S. Julia; H, C.Y. Ling)

0.6 × 0.2 mm, apex emarginate. *Female flowers* not seen. *Capsules* in pairs, oblong in outline, 15–26 × 10–17 mm, locules 3, wings 3, equal, rounded or truncate proximally, truncate distally, 5–6 mm wide, dehiscent between the locules and wings; pedicel in fruit pendent, stiff, 4–6 mm long.

*Etymology.* Latin, *crassus* = thick, referring to the stem.

*Distribution.* Endemic in Sarawak, as yet known only from Lanjak Entimau WS.

*Habitat.* Usually in riparian forest at 110–390 m elevation, growing below a cascading waterfall on a thin layer of soil on constantly wet sandstone boulders or on rocky banks of small streams; sometimes on slopes in mixed dipterocarp forest.

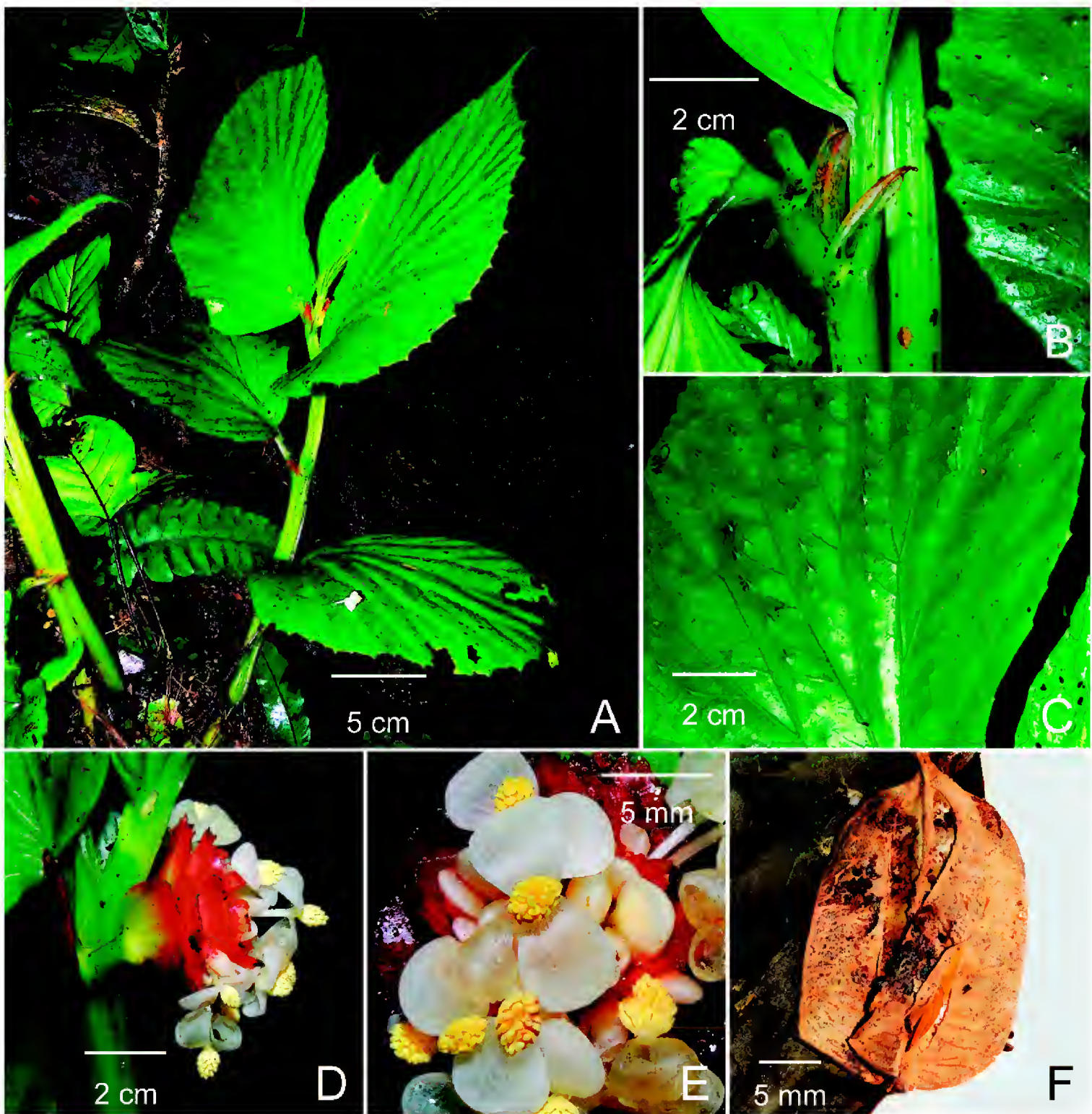
*Notes.* *Begonia crassa* was first collected in 1998 and is apparently widespread in the Lanjak Entimau WS. However, the species appears to grow in very small localised populations. Measurement of the fruit is based on dried herbarium specimens (*S79226* and *S90774*). Locally, its young leaves are used for flavouring when boiling fish. Among Bornean begonias, it is remarkable for its extremely thick, succulent (not woody), angled stem to 1.5 cm thick. The only other species with a ridged stem is *Begonia papyraptera* Sands from Brunei, but it is quite different. Its ridged stem is conspicuously winged, it has broadly ovate, spotted leaves, and much larger capsules. Nor do these two species occupy an unusual or specific habitat that could be associated with this type of stem.

*Additional specimens examined.* MALAYSIA: **Sarawak:** Julau District, Lanjak Entimau WS, Sg. Merinum via Pakan, 2 Nov 1998, *Julaihi et al.* *S79226* (SAR!, K, KEP, L); Lanjak Entimau WS, Ng. Biladayat, Ulu Sg. Sugai, Mujok, 3 Mar 2003, *Rantai et al.* *S90774* (SAR!, KEP, K, L, SAN); Sg. Mujok, Sg. Sugai, 24 May 2016, *Ling & Dino* *SFC5952* (SAR!); Mujok, Lanjak Entimau WS, Sg. Sengkadang, 22 May 2016, *Ling & Dino* *SFC5941* (SAR!); Lubok Antu District, Ulu Engkari, Lanjak Entimau WS, Sungai Jela, 14 Mar 2016, *Julia et al.* *SFC3467* (SAR!); Song District, Hulu Katibas, Sg. Sedin, *Mohizah et al.* *ITTO/BC0083* (SAR!).

#### 4. *Begonia devexa* S.Julia & Kiew, sp. nov. (Section *Petermannia*)

In its leaves with long erect hairs on the upper surface and the erect unbranched inflorescences with 2-tepaled male flowers, it is similar to *Begonia corrugata* Kiew & S.Julia but it differs in its smaller and sometimes slightly falcate leaves, 9.5–13.5 × 4.5–5.2 cm (vs. 14–25 × 9–16 cm), its smaller basal lobe 0.8–1 cm long (vs. 1.5–4 cm long), glabrous tepals (vs. hairy tepals) and smaller capsules 9–10 × 12 mm (vs. 15–20 × 12–15 mm). – TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Lanjak Entimau WS, Sungai Segerak, 1°24'34"N 112°00'13"E, 371 m, 13 March 2016, *Julia et al.* *SFC3457* (holotype SAR!; isotypes KEP!, SING!, SNP!). (Fig. 4)

Erect herb 20–35 cm tall, whole plant pilose, hairs white or rarely reddish to 5 mm long. **Stems** sometimes with one or two slender branches, pale green, 4–5 mm thick; internodes 2–3.5 cm long, slightly swollen at nodes. **Stipules** pale green, ovate, 9–15 × 5–11 mm, keeled, margin entire, apex setose, seta to c. 2 mm long, persistent. **Leaves** sometimes flattened against the steep earth bank, oblique; petioles pale green, (0.8–)3–3.7 cm long, slightly grooved; lamina plain green above, paler beneath, upper surface sprinkled with white or rarely reddish hairs 3–5 mm long, margin ciliate, beneath veins



**Fig. 3.** *Begonia crassa* S.Julia & Kiew. **A.** Habit. **B.** Stipule. **C.** Upper leaf surface. **D, E.** Male inflorescence. **F.** Fruit. A–E from *SFC3467*; F from *S90832*. (Photos: A–E, S. Julia; F, C.Y. Ling)

pilose, in life succulent, drying papery, asymmetric, ovate to slightly falcate, 9.5–13.5 × 4.5–5.2 cm, broad side 2.5–3.5 cm, narrow side in falcate leaves slightly concave, base cordate, unequal, basal lobe 0.8–1 cm long, margin finely serrate, apex acuminate, acumen 4–15 mm long; venation palmate-pinnate, c. 4 veins on each side, 4 veins on basal lobe, branching 1–2 times towards the margin, concolorous, slightly impressed above, prominent beneath. **Inflorescences** erect, from the upper leaf axils, greenish, unbranched, 3–5.5 cm long, peduncle c. 1.5 cm long. **Bracts** pale green, ovate, c. 12 × 7–9 mm, margin fringed by hairs to 2 mm long, persistent; bracteoles up to 9 pairs per inflorescence, pale green, ovate, lower bracteoles 10–12 × 7–9 mm, upper ones c. 8 × 7 mm, margin fringed by hairs to 2 mm long, persistent. **Male flowers** with white

glabrous pedicels, 8–12 mm long; tepals 2, white, glabrous, margin entire, apex acute, 6–8 × 5–6 mm; stamens 7–10, cluster loosely globose, stalked to 1 mm long, filaments 0.8–1 mm long, anthers pale yellow, obovate, 0.6–1 × 0.2–0.5 mm, apex emarginate. **Female flowers** with pale green and pilose pedicels, 7–10 mm long; tepals 5, greenish white, hairy outside, glabrous inside, margin toothed on the upper half, apex broadly acute, outer 3 tepals elliptic, 8–11 × 5–7 mm, inner 2 tepals narrowly elliptic, c. 9 × 5 mm; ovary pale green, slightly darker and pilose on the wings, 12–16 × 9–14 mm, wings 3, equal, 3–4 mm wide, locules 3, placentas 2 per locule; styles 3, pale yellow, 4–5 mm long; stigma pale yellow, deeply Y-shaped, papillose, forming a continuous twisted band. **Capsules** single, pale green, 9–14 × 8–12 mm, locules 3, wings 3, equal, acute proximally and truncate distally, 2–4 mm wide, dehiscing between the locules and wings; pedicel in fruit straight, pale green, glabrous, 6–7 mm long.

**Etymology.** Latin, *devexus* = sloping downwards; referring to the leaves that point downwards against the steep slope on which they grow.

**Distribution.** Endemic in Sarawak, as yet known only from Lanjak Entimau WS.

**Habitat.** Steep earth or rocky slopes in riparian forest at 370 m elevation, in semi-shaded area.

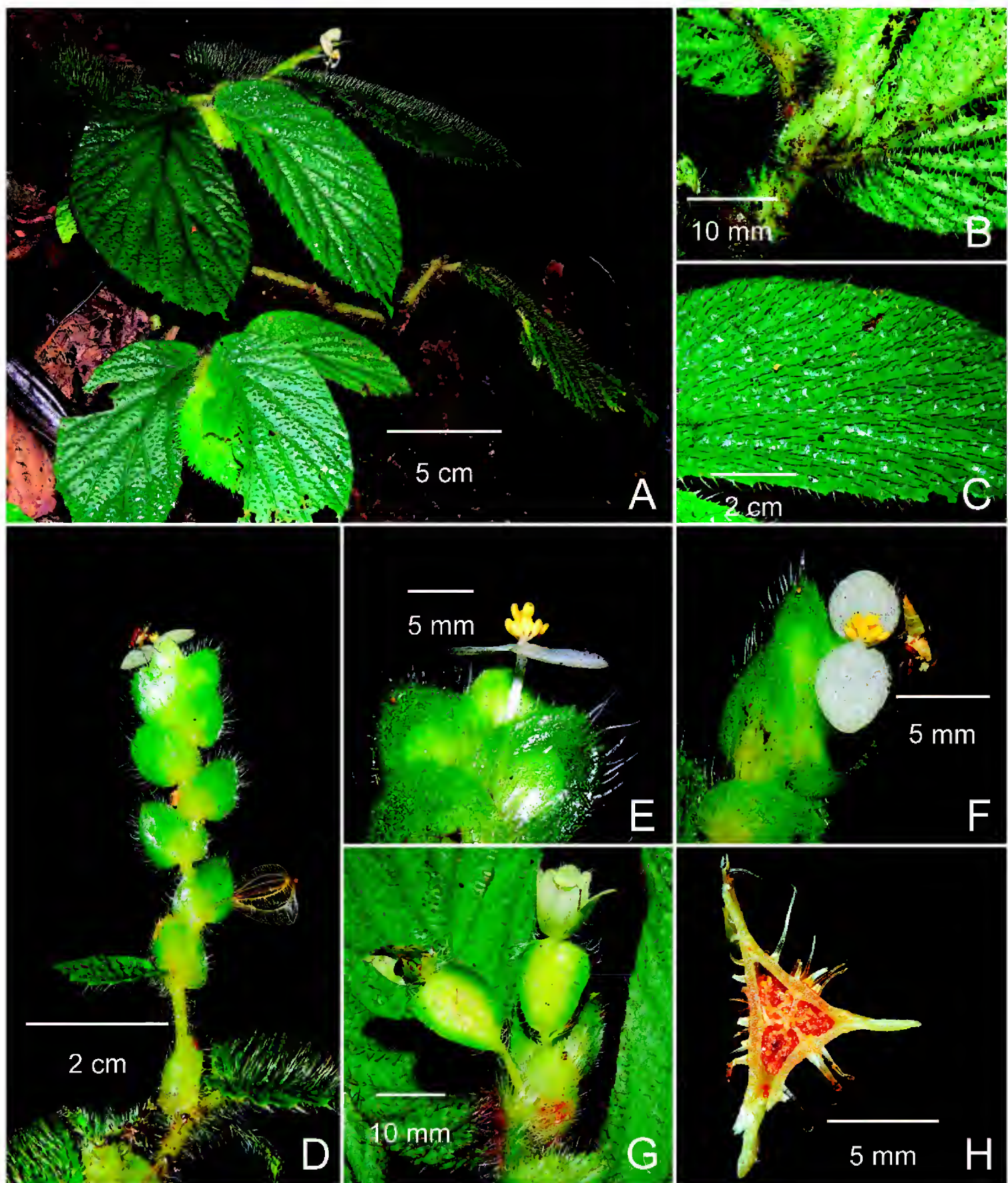
**Notes.** Falcate leaves are unusual among Bornean begonias and are only seen in narrow-leaved species, like *Begonia eutricha* Sands and *B. melanosticta* F.Y.Chong & V.S.Guanih. Even so, the curvature is not pronounced and nor are all leaves on a single plant noticeably falcate. *Begonia devexa* is also notable in having very few stamens compared with most species that have at least ten and frequently more than twenty. *Begonia baramensis* has the most, 49–84 stamens.

**5. *Begonia fractiflexa* S.Julia & Kiew, sp. nov.** (Section Uncertain)

Similar to *Begonia bosuangiana* S.Julia in its rounded, hairy leaves but it differs in its long creeping wiry stem (vs. stem to 4 cm long), its very small stipule c. 4 × 2 mm and lamina 1.5–3 × 2–2.5 cm (vs. stipule c. 6 × 4 mm and lamina c. 5 × 5.3 cm), larger tepals, 5–6 × 5 mm in the female flower (vs. 3 × 2 mm), and capsule 5–6 × 5 cm with narrower wings 1–1.5 mm wide (vs. capsule broader than long, 5–6 × 9–12 mm with wider wings 6–9 mm wide). –TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Ulu Engkari, Lanjak Entimau WS, Sungai Jela, 1°25'50"N 112°00'07"E, 366 m, 14 March 2016, *Julia et al.* SFC3466 (holotype SAR!; isotypes KEP!, SING!, SNP!). (Fig. 5)

Creeping wiry herb to 28 cm long. **Stem** and petiole densely woolly, dark or reddish brown, c. 2 mm thick, unbranched; internodes 1.5–2.6 cm long, slightly thicker at nodes. **Stipules** brownish green, lanceolate, c. 4 × 2 mm, margin ciliate, apex setose, seta to 1 mm long, persistent. **Leaves** alternate, distant, not oblique, held horizontally;





**Fig. 4.** *Begonia devexa* S.Julia & Kiew. **A.** Habit. **B.** Stipule and lower leaf surface. **C.** Upper leaf surface. **D.** Male inflorescence and old fruit. **E, F.** Male flower. **G.** Female flowers. **H.** Cross-section of ovary. From the type *SFC3457*. (Photos: A–G, S. Julia; H, C.Y. Ling)

petioles red brown, 1.5–3.4 cm long, terete; lamina plain mid-green and hirsute above, hairs blackish, pale green and glabrous beneath, in life succulent, sometime iridescent, more or less symmetric, rounded, 1.5–3 × 2–2.5 cm, base cordate, margin finely serrate, apex rounded; venation palmate, veins 6, prominent above, raised below. Inflorescences protogynous, axillary on upper parts of the stem, with one female

flower on a lower branch and up to 3 male flowers on upper branch, zig-zag, erect, 4.5–7.5 cm long, red or pinkish or white towards apex. **Bracts** deep red, lanceolate, c. 4 × 2 mm, margin ciliate, persistent; bracteoles white or reddish (lower bracteoles of female inflorescence), ovate, c. 3 × 2 mm, margin toothed, up to 5 pairs, persistent. **Male flowers:** pedicel white, c. 8 mm long, glabrous; tepals 4, completely white, glabrous, outer 2 tepals oblong, c. 8 × 5 mm, margin entire, apex rounded, inner 2 tepals lanceolate, c. 7 × 3 mm, margin entire, apex acute; stamens c. 14, cluster conical, sessile, filaments pale yellow, c. 1 mm long, anthers pale yellow, obovate, c. 0.8 × 0.3 mm, apex emarginate. **Female flowers:** pedicel pale pink, 1–3 mm long, glabrous; tepals 5, white, outer 4 tepals elliptic, c. 6 × 4 mm, margin entire, apex acute, innermost tepal lanceolate, c. 5 × 2 mm; ovary pinkish, wings white, c. 6 × 8 mm, glabrous, wings 3, equal, locules 3, placenta 1 per locule; styles 3, pale yellow, c. 2 mm long, divided to base, anchor-shaped; stigma pale yellow, papillose, forming a continuous twisted band. **Capsules** (old) 2 per stalk, single on the lower branch, 5–6 × 5 mm, glabrous, locules 3, wings 3, equal, acute proximally and distally, 1–1.5 mm wide, thinly fibrous, dehiscent between locule and wing; pedicel in fruit pendent, thread-like, 5–7 mm long.

**Etymology.** Latin, *fractiflexus* = zig-zag, referring to the shape of the rachis in the male inflorescence.

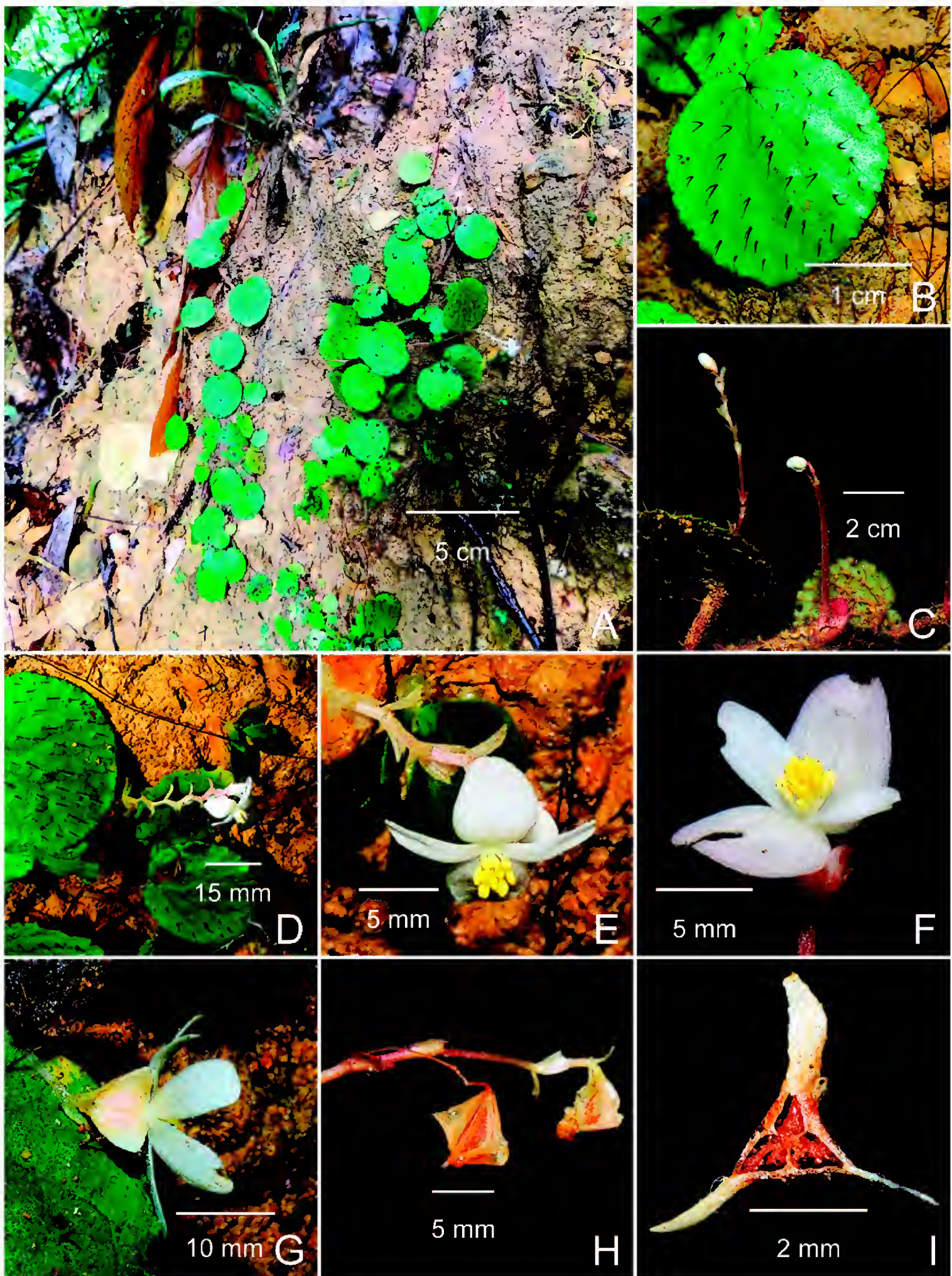
**Habitat.** Riparian forest below 400 m elevation. Growing on steep earth slopes or on sandstone boulders with thin layer of soil, in semi-shaded area.

**Distribution.** Endemic to Sarawak and so far only known from the type locality.

**Note.** Doorenbos et al. (1998) highlighted the importance of the number of placentas per locule in assigning species to sections. Bornean species with one placenta, as in this species, are placed in *Begonia* sect. *Reichenheimia*. However, *Begonia fractiflexa* is anomalous for this section in being protogynous and lacking a rhizome, both diagnostic characters for *Begonia* sect. *Petermannia*. In addition, many species in *Begonia* sect. *Reichenheimia* have peltate leaves. More specimens in all stages of development of the ovary and fruit are needed to ascertain whether the single placenta in *Begonia fractiflexa* is the result of the failure of one placenta to develop.

**6. *Begonia hirtitepala* S. Julia & Kiew, sp. nov. (Section *Petermannia*)**

In its cane-like habit, broad obovate leaves and male flowers with 2 tepals, it is similar to *Begonia flavovirens* Kiew & S. Julia but it differs in the hispid indumentum on its stem, leaves, flowers and fruits, in its broader lamina 12.5–18 × 5.5–11 cm (vs. laminae 11–18 × 5.5–9 cm), smaller stipule 8–18 × 3–4 mm (vs. c. 20 × 7 mm), female flower with 3, rarely 4 tepals (vs. 5 tepals) and smaller capsules wider than long, c. 9 × 16 mm (vs. capsules 10–24 × 10–19 mm). – TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Batang Ai NP, Sungai Kenaban, 1°18'42"N 112°04'22"E, 19 March 2016, Julia et al. SFC6614 (holotype SAR!; isotypes KEP!, SING!, SNP!). (Fig. 6)



**Fig. 5.** *Begonia fractiflexa* S.Julia & Kiew. **A.** Habit. **B.** Hairy upper leaf surface. **C.** Young inflorescence. **D.** Male inflorescence. **E, F.** Male flower. **G.** Female flower. **H.** Fruits. **I.** Cross-section of ovary. From the type *SFC3466*. (Photos: A–H, S. Julia; I, C.Y. Ling)

Erect begonia to 1.6 m tall. *Indumentum* of stem, stipules, petioles, bract and bracteoles densely hispid, hairs dark brown to whitish towards apex, 3–6 mm long. *Stem* much-branched, dark brown or blackish, succulent, slender, 5–9 mm thick, internodes (2–)4.5–9 cm long, thicker at nodes. *Stipules* pale green, lanceolate, 8–18 × 3–4 mm, margin entire, keeled, apex setose, seta 2–5 mm long, caducous. *Leaves* alternate, distant, held vertically, slightly oblique; petiole greenish, 0.9–1.8 cm long, slightly grooved above; lamina plain dark green above, paler beneath, sprinkled with hairs above, hairs c. 1 mm long, in life slightly succulent, matt, slightly asymmetric, obovate, 12–18 × 5–10 cm, broad side 3–6 cm wide, base unequal, basal lobe rounded, 0.6–0.8 cm long, margin hispid, minutely dentate, apex acuminate, acumen 5–1.3 mm long; venation pinnate, veins 5–6 pairs, concolorous on both surfaces, densely pilose, 1–2 veins in basal lobe, impressed above, raised below. *Inflorescences* protogynous, dense paniculate, densely hispid, 3–7 cm long. *Bracts* pale green, lanceolate, 15–22 × 4–8 mm, keeled, margin hispid, apex setose, seta to 1 mm long, persistent; bracteoles similar to bracts, lanceolate, persistent, lower bracteoles 11–18 × 2–5 mm, upper ones 5–9 × 2 mm. *Male flowers* with white pedicels, 2–7 mm long; tepals 2, white, densely hispid outside, hairs white, to 2 mm long, glabrous inside, oval, 5–7 × 4–5 mm, margin entire, apex acute; stamens 30–34, cluster conical, stalked to 0.8 mm long, filaments 0.8–1 mm long, anthers pale yellow, obovate, 0.8–1 × 0.3–0.5 mm, apex emarginate. *Female flowers* with greenish pedicels 3–5 mm long, sparsely hairy; tepals 3, rarely 4, white or greenish, hirsute outside, glabrous inside, ovate, 7–8 × 4–5 mm, margin toothed, teeth tipped by a hair, apex acute; ovary greenish, reddish in the centre, sparsely hairy, ovate, 10–11 × 12–13 mm, wings 3, equal, locules 3, placentas 2 per locule; styles 3, pale green; stigma shallowly Y-shaped, 2–3 mm long, divided to base, papillose, forming a continuous twisted band. *Capsules* single or in pairs, axillary, hispid, 7–12 × 8–13 mm, truncate proximally, distally with pointed tip, locules 3, wings 3, equal, wings 4–7 mm wide, papery, dehiscing between the locule and wing; pedicel in fruit 2–6 mm long, pale green.

*Etymology.* Latin, *hirtus* = softly hairy; *tepalus* = tepal; referring to the conspicuously hairy tepals.

*Distribution.* Endemic in Sarawak, known from Batang Ai NP and Lanjak Entimau WS.

*Habitat.* Riparian forest below 200 m elevation on gentle slopes in deep shade along slightly disturbed riverbank.

*Additional specimen examined.* MALAYSIA: **Sarawak:** Song District: Ng. Biladajat, Ulu Sg. Mujok, Lanjak Entimau WS, 28 Feb 2003, *Rantai et al.* S90586 (SAR!, KEP, K, L).

*Notes.* Among begonias in Batang Ai NP (Julia & Kiew, 2016), in its habit and hispid leaves *Begonia hirtitepala* is most similar to *B. edgariana* S. Julia & Kiew but it is different in its longer petiole, much larger lamina (6–14 × 2.5–6.5 cm) and dense paniculate inflorescence with 3 tepals in the female flowers.



**Fig. 6.** *Begonia hirtitepala* S.Julia & Kiew. **A, B.** Habit; **C.** Hairy upper leaf surface. **D.** Inflorescence. **E.** Male inflorescence. **F, G.** Female flower. **H.** Female flower and fruit. **I.** Cross-section of ovary. From the type *SFC6614*. (Photos: A–H, S. Julia; I, C.Y. Ling)

**7. *Begonia jambilahanuiana* S.Julia, sp. nov.** (Section *Petermannia*)

This species resembles *Begonia malachosticta* Sands in its habit and narrowly ovate leaves that are spotted in the adult plant but it differs in the spots being white (vs. bright pink in *B. malachosticta*), male flowers with 2 tepals (vs. 4 tepals), fewer stamens 27–32 (vs. stamens 75–85 in *B. malachosticta*) and smaller capsules 11–17 × 11–15 mm

with unequal wings (vs. 20–25 × 10–15 mm with equal wings). – TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Lanjak Entimau, Tinteng Kuap, 1°24'31"N 112°00'18"E, 590 m, 12 March 2016, *Julia et al.* SFC3446 (holotype SAR!; isotypes KEP!, SING!). (Fig. 7)

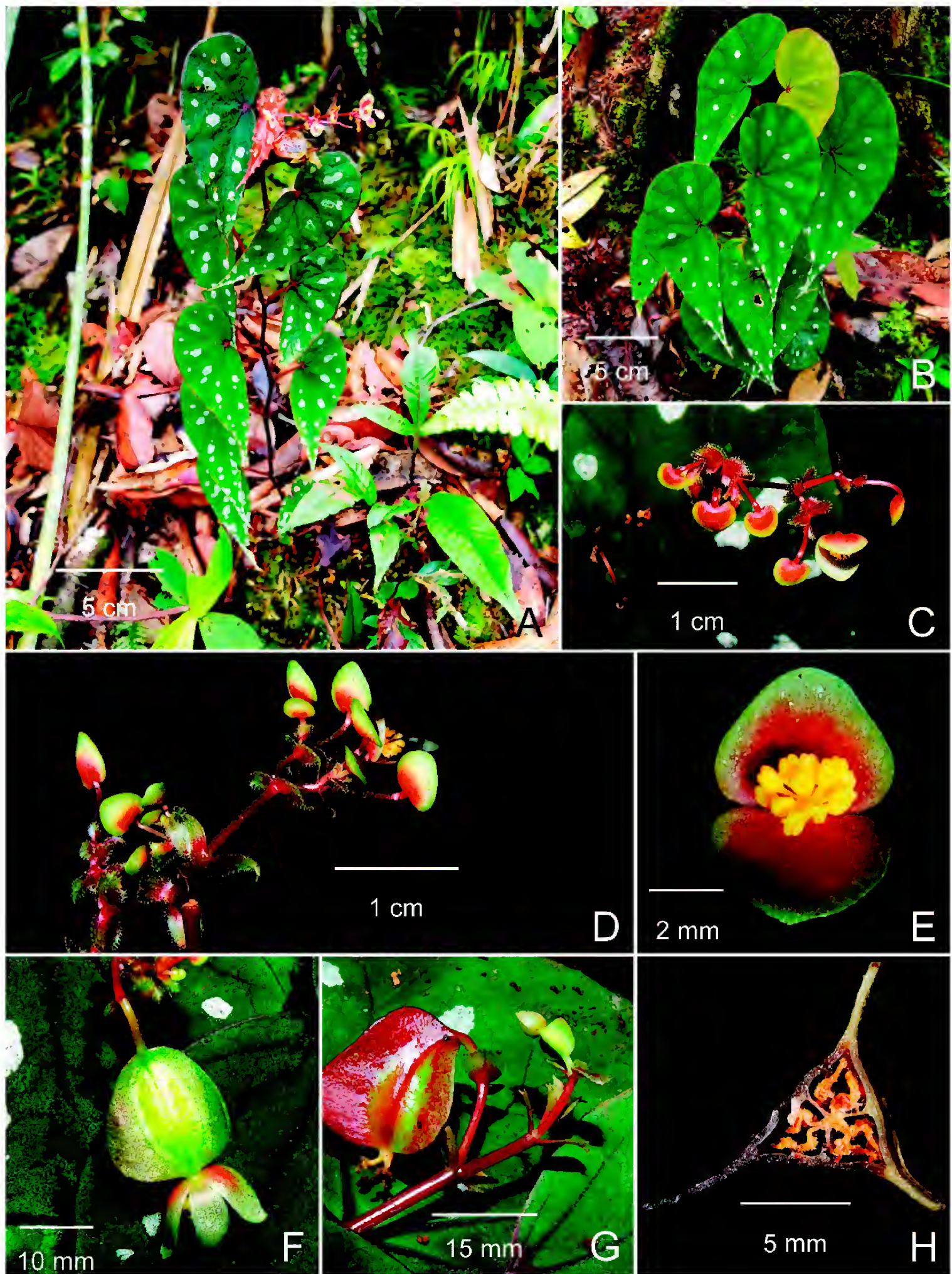
Cane-like begonia, whole plant glabrous. **Stems** to 60 cm tall, little-branched, dark red, slender, 4–5 mm thick; internodes 3–7 cm long. **Stipules** caducous. **Leaves** distant, held more or less vertically, oblique; petioles red brown, 3.3–6 cm long, succulent; lamina dark green with white spots between veins above, white spots persistent on adult plant, pale green beneath, succulent, drying papery, asymmetric, broadly lanceolate, 6–13 × 2.5–5 cm, broad side 1.5–4.7 cm long, base cordate, unequal, basal lobe 2.3–5 cm long, margin shallowly dentate, apex acuminate, acumen 1.3–2.5 cm long; venation palmate-pinnate with 3–4 veins at the base, to twice branching towards the margin and 3–4 veins on either side of the midrib, red brown on both surfaces, slightly raised above, prominent beneath. **Inflorescences** protogynous, axillary in upper leaf axils, paniculate, 7–15 cm long, peduncle 1.3–12 cm long. **Bracts** red, ovate, 6–7 × 3–4 mm, margin entire, keeled, apex setose, seta to 2 mm long, caducous; bracteoles 3–6 pairs, 2–6 × 2–5 mm, margin toothed, persistent. **Male flowers** with reddish pedicels, 6–11 mm long; tepals 2, reddish at base, otherwise yellowish, greenish or pinkish, ovate, 6–7 × 5 mm; stamens 27–32, cluster globose, sessile, filaments yellow, c. 1 mm long, anthers yellow, obovate, c. 0.8 × 0.5 mm, apex emarginate. **Female flowers** with reddish or reddish green pedicels, 5–6 mm long; tepals 5, yellowish, outer 3 tepals elliptic, c. 7 × 5 mm, margin entire, apex acute, inner 2 tepals narrowly elliptic, c. 6 × 3 mm; ovary pale green, 17–20 × 13–15 mm, wings 3, unequal, 2–4 mm wide, locules 3, placentas 2 per locule; styles 3, yellowish, c. 2 mm long; stigma yellowish, deeply Y-shaped, papillose, forming a continuous twisted band. **Capsules** in life pale green or reddish green, 11–17 × 11–15 mm, locules 3, wings 3, unequal, narrow wing acute to rounded proximally, narrowly to broadly rounded distally, c. 2 mm wide, two broader wings truncate proximally and distally, c. 4 mm wide, dehiscing between the locules and wings; pedicel in fruit pendent, reddish, 5–10 mm long.

**Etymology.** Named in honour of YA Bhg. Datin Patinggi Dato Hajah Jamilah bt. Haji Anu, wife of the fifth and current Chief Minister of Sarawak.

**Distribution.** Endemic in Sarawak, as yet known only from Lanjak Entimau WS and Batang Ai NP.

**Habitat.** Hill mixed dipterocarp forest below 600 m elevation, on shaded ridges with a thick layer of leaf litter on loamy clay soils.

**Notes.** It is an attractive begonia unusual in retaining its white spots even in adult plants. Many begonias have spotted juvenile foliage but usually the spots gradually disappear in the older leaves. Distinctly unequal wing width in capsules in *Begonia* sect. *Petermannia* is extremely unusual. The most extreme case is seen in *Begonia*



**Fig. 7.** *Begonia jamilahanuiana* S.Julia. **A.** Habit of flowering plant. **B.** Habit of young plant. **C, D.** Male inflorescence. **E.** Male flower. **F.** Female flower. **G.** Fruit. **H.** Cross-section of ovary. From the type *SFC3446*. (Photos: A–G, S. Julia; H, C.Y. Ling)

*amphioxus* where one wing and one locule may not develop at all. However, an examination of *Begonia amphioxus* in the field shows that there is a complete continuum from capsules with three locules and three equal wings to those with three locules and two wings, the third being much reduced in size, to capsules with two locules and two wings (Kiew, 2001).

Among species in the Batang Ai NP (Julia & Kiew, 2016), it most resembles *Begonia acidulenta* that also has a cane-like habit, flowers in branched inflorescences and spotted leaves. *Begonia acidulenta* differs from *B. jambilahanuiana* in losing its spots in adult plants, in its much larger leaves 14–22 × 10.5–17 cm with petioles 4.3–8.5 cm long and its male flowers with 4 tepals, not 2 as in *B. jambilahanuiana*.

The habitat of *B. jambilahanuiana* on shaded ridges is unusual because begonias usually grow in valleys or close to streams.

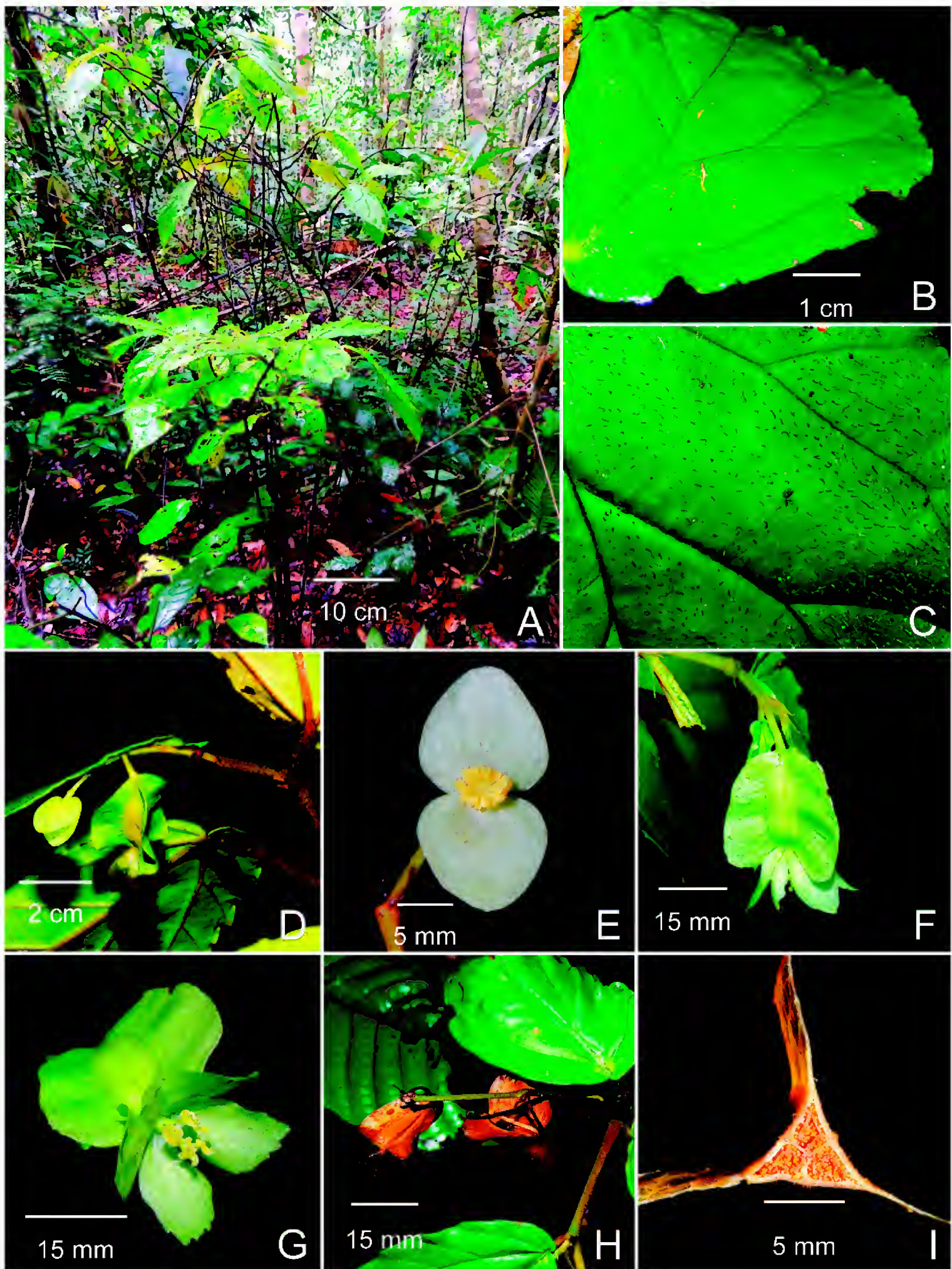
*Additional specimen examined.* MALAYSIA: Sarawak: Lubok Antu District: Batang Ai NP, Lubang Baya, Lubok Aping trail, 17 Mar 2016, Shalih et al. SFC6567 (SAR!, SING!).

#### 8. *Begonia ubahribuensis* S. Julia & Kiew, sp. nov. (Section *Petermannia*)

This species resembles *Begonia lailana* Kiew & Geri in its cane-like habit, glabrous female flower with toothed tepals and similar fruits but it differs in having shorter internodes, 3.5–4.5 cm long (vs. 7–11 cm long), smaller stipules, 5–7 × 2 mm (vs. 15–27 × 6–10 mm), shorter inflorescence, 2–5.5 cm long (vs. 10–15 cm long), smaller tepals in male flower, 9–12 × 9–12 mm (vs. 15–18 × 9–10 mm) and larger outer and inner tepals in female flower, respectively 15–16 × 6–10 mm and 15–16 × 6–10 mm (vs. 6–12 × 3–8 mm and 4–10 × 3–7 mm respectively). –TYPE: Malaysia, Borneo, Sarawak, Lubok Antu District, Ulu Engkari, Lanjak Entimau WS, Nanga Segerak, trail to Ubah Ribu, 1°25'12"N 112°00'16"E, 506 m, 15 March 2016, Julia et al. SFC3462 (holotype SAR!; isotypes KEP!, SING!, SNP!). (Fig. 8)

Erect begonia to 1.57 m tall. **Stem** unbranched to much-unbranched, blackish or greenish, pubescent, slightly woody, slender, 6–8 mm thick, internodes 3.5–4.5 cm long, thicker at nodes. Stipules pale green, lanceolate, 5–7 × 2 mm, margin entire, apex setose, seta to 2 mm long, caducous. **Leaves** alternate, distant, held more or less horizontally, slightly oblique; petiole dull red-brown, 0.4–0.8 cm long, slightly grooved above; lamina plain mid-green above, paler beneath, glabrous on both surfaces or hirsute above, hairs brownish or dark brown, glabrous below, in life slightly succulent, matt, slightly asymmetric, obovate, elliptic or ovate, 10–17.5 × 4.3–7 cm, broad side 2.5–4.5 cm wide, base unequal, basal lobe rounded, 0.3–0.8 cm long, margin dentate and wavy, apex acuminate, acumen 10–20 mm long; venation pinnate, 3–5 veins on each side of the midrib, concolorous, glabrous, 2–3 veins in basal lobe, strongly impressed above, raised below. **Inflorescences** protogynous, glabrescent, racemose, 2–5.5 cm long, peduncle 1–2.5 cm long. **Bracts** pale green, lanceolate, 7–12 × 2 cm, apex setose, seta to 3 mm long, caducous, bracteoles similar but slightly smaller, 5–10 × 2 mm, caducous. **Male flowers** with pale green pedicels, 4–10 mm long; tepals 2,





**Fig. 8.** *Begonia ubahribuensis* S.Julia & Kiew. **A.** Habit. **B.** Glabrous upper leaf surface. **C.** Hairy upper leaf surface. **D.** Inflorescence and old fruit. **E.** Male flower. **F, G.** Female flower. **H.** Fruit. **I.** Cross-section of ovary. A, C–H from *SFC3462*; B from *SFC3460*; I from *SFC3462*. (Photos: A–H, S. Julia; I, C.Y. Ling)

pale green or greenish yellow, glabrescent outside, hairs whitish, glabrous inside, oval, 9–12 × 9–12 mm, margin entire, apex broadly acute; stamens 38–46, cluster globose, sessile, filaments 0.8–1 mm long, anthers pale yellow, obovate, 0.9–1 × 0.5 mm, apex emarginate. *Female flowers* with greenish pedicels, 5–7 mm long, glabrescent; tepals 5, greenish or greenish yellow, glabrescent outside, glabrous inside, ovate or elliptic, outer 4 tepals 15–18 × 9–10 mm, inner tepal 15–16 × 6–10 mm, margin entire or toothed on the upper half, apex acute; ovary greenish, glabrescent, obovate, 14–18 × 19–22 mm, wings 3, equal, locules 3, placentas 2 per locule; styles 3, greenish yellow; stigma deeply Y-shaped, 3 mm long, divided to base, papillose, forming a continuous twisted band. *Capsules* up to 3 per infructescence, axillary, glabrescent, 10–20 × 11–20 mm, acute proximally, truncate or rounded distally, locules 3, wings 3, equal, wings 7–14 mm wide, papery, dehiscing between the locule and wing; pedicel in fruit pendent, 6–12 mm long, pale green.

*Etymology.* Named for the Ubah Ribu trail in Lanjak Entimau WS where it was commonly found.

*Distribution.* Endemic in Sarawak, known only from the Lanjak Entimau WS.

*Habitat.* Mixed dipterocarp forest on gentle slope along the ridge in semi-shaded areas.

*Notes.* Individual plants observed in Lanjak Entimau WS vary in having blackish or greenish stems, lamina either completely glabrous on both sides or sprinkled with hirsute black hairs above, glabrous below and the margin of tepals in female flower either entire or toothed. It is common where it occurs.

*Additional specimens examined.* MALAYSIA: **Sarawak:** Lubok Antu District: Ulu Engkari, Lanjak Entimau WS, Tinting Jela along Ubah Ribu trail, 14 Mar 2016, *Julia et al.* SFC3460 (SAR!, SING!); Song District, Lanjak Entimau WS, 19 Mar 1998, *Pearce et al.* S77628 (SAR!).

**ACKNOWLEDGEMENTS.** We gratefully acknowledge financial assistance from Sarawak Forestry Corporation for supporting the field work under RIMBA SARAWAK project. We are indebted to the management team of Sarawak Forestry Corporation, Chief Executive Officer, Deputy General Managers and Regional Managers, for their continuous support and guidance. We thank our fellow colleagues from Lanjak Entimau WS, Batang Ai NP and AFSID for their valuable assistance and cooperation during the field work. Also thanks to the visiting researchers from Singapore Botanic Gardens (Michele Rodda and Paul Leong) for their participation during the first author's trip, to the Curator of Sarawak Herbarium, Hajjah Mohizah Mohamad, for allowing us to access the herbarium specimens in her care, and to Daniel C. Thomas for his helpful suggestions for improving the manuscript. Lastly, we thank Ling Chea Yiing for her assistance in preparing the plates and for providing the photographs.

## References

- Chai, P.P.K. (2011). *The Lanjak Entimau Story: Changing Landscape in Biodiversity Conservation*. 155 p. Sarawak, Kuching: International Tropical Timber Organisation and Forest Department Sarawak.
- Doorenbos, J., Sosef, M.S.M. & De Wilde, J.J.F.E. (1998). The sections of *Begonia* including descriptions, keys and species lists (Studies in Begoniaceae VI). *Wageningen Agric. Univ. Pap.* 98(2): 1–266.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. Switzerland, Gland & UK, Cambridge: IUCN.
- Julia, S. & Kiew, R. (2016). *Begonia* (Begoniaceae) from Batang Ai National Park and the adjacent area, Sarawak, Borneo, including six new species. *Phytotaxa* 252(1): 17–30.
- Kiew, R. (2001). The limestone begonias of Sabah, Borneo – Flagship species for conservation. *Gard. Bull. Singapore* 53: 241–286.
- Meekiong, K., Ampeng, A., Madeline, G.P., Ipor, I.B., Sapuan, A. & Mohamed, H. (2010). *The Heart of Borneo Series – Lanjak Entimau Wildlife Sanctuary: Sarawak's Hidden Jewel*. Kuching: Forest Department Sarawak & Universiti Malaysia Sarawak.
- Lin, C.W., Chung, S.W. & Peng, C.-I. (2014). *Begonia baik* and *B. padawanensis* spp. nov. (Begoniaceae) from sandstone areas in Sarawak, Malaysia. *Nordic J. Bot.* 33(5): 1–7.



## Studies on *Begonia* (Begoniaceae) of the Moluccas III: A new *Begonia* from Seram, Indonesia

N.K.E. Undaharta<sup>1</sup> & W.H. Ardi<sup>2</sup>

<sup>1</sup>Bali Botanic Garden, Candikuning, Baturiti, Tabanan,  
Bali, 82191, Indonesia  
nika002@lipi.go.id

<sup>2</sup>Bogor Botanic Garden, Jl. Ir. H. Juanda No. 13,  
Bogor, Indonesia  
wisn001@lipi.go.id

**ABSTRACT.** A new species of *Begonia*, *Begonia nephrophylla* Undaharta & Ardi, is described from Manusela National Park, Seram Island, Moluccas, Indonesia. The species is endemic to Seram and belongs to *Begonia* section *Petermannia*. An illustration of the new species and a key to the Moluccan species of *Begonia* is presented.

**Keywords.** *Begonia*, Indonesia, Moluccas, new species

### Introduction

*Begonia* (Begoniaceae) is one of the largest genera of flowering plants and most species are found in the understorey in tropical forests (Tebbitt, 2005). The Moluccas have relatively few species compared to the other islands in the eastern part of Indonesia, Sulawesi and Papua. As for most of the region, the *Begonia* flora of the islands is poorly known, as indicated by recent new species discoveries (Wiriadinata, 2012; Ardi et al., 2014; Ardi & Thomas, 2015; Ardhaka et al., 2016;) and as-yet undescribed species in both living and herbarium collections. Currently there are eight species known from the Moluccas, of which six are endemic to the archipelago or locally endemic to a single island (Table 1).

During the *Begonia* expedition to Seram which was carried out by “Eka Karya” Bali Botanical Gardens, Indonesian Institute of Sciences (LIPI) in 2010, several specimens suspected to be new to science were collected. Here a new species, named *Begonia nephrophylla* Undaharta & Ardi, is described from material collected in Seram and cultivated at Bali and Bogor Botanic Gardens. The species belongs to *Begonia* section *Petermannia* (Klotzsch) A.DC. which is characterised by protogynous inflorescences, 2-flowered female inflorescences or solitary female flowers, 3-locular ovaries with axile placentation and bilamellate placentae, fruits with equal or subequal wings, and anthers with unilaterally positioned slits (Doorenbos et al., 1998). All available *Begonia* specimens from BO, E, K, L and SING (Thiers, continuously updated) have been consulted without any additional material being found and hence it must be assumed, at least until more intensive collecting reveals otherwise, that this species has a restricted range and is endemic to Seram.

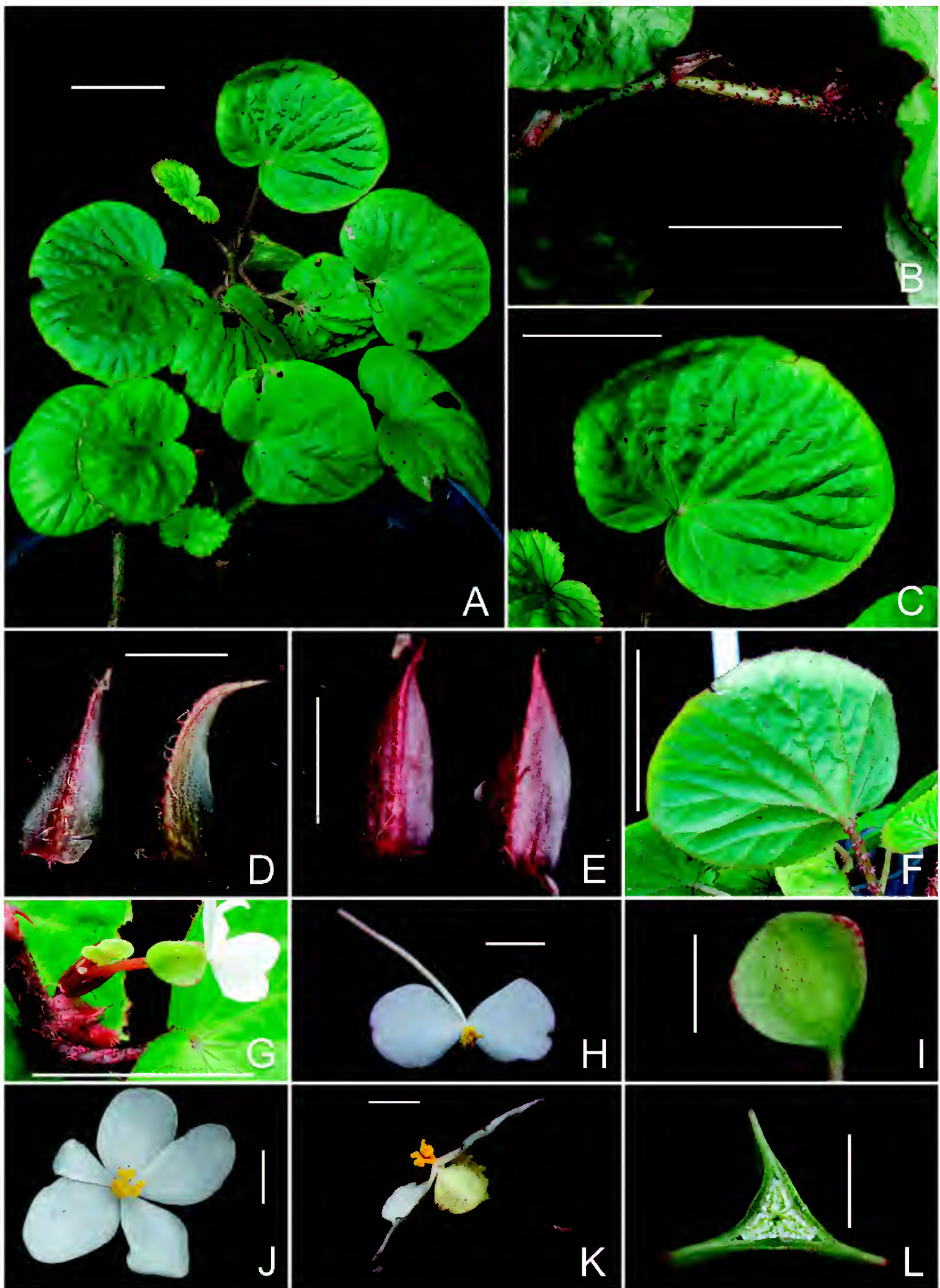
**Table 1.** *Begonia* species of the Moluccas (Wiriadinata, 2012; Ardi et al., 2014; Ardi & Thomas, 2015; Hughes et al., 2015; Ardhaka et al., 2016).

Species	Locality
<i>Begonia aptera</i> Blume	Mollucas, Papua, Sulawesi
<i>Begonia aketajawensis</i> Ardi & D.C.Thomas	Halmahera
<i>Begonia galeolepis</i> Ardi & D.C.Thomas	Seram
<i>Begonia holosericea</i> (Teijsm. & Binn.) Teijsm. & Binn.	Ternate
<i>Begonia holosericeoides</i> Ardi & D.C.Thomas	Halmahera
<i>Begonia manuselaensis</i> Ardhaka & Ardi	Seram
<i>Begonia rieckei</i> Warb. complex species	Mollucas, Papua, Sulawesi Phillipines, Pacific Islands
<i>Begonia sageaensis</i> Wiriad.	Halmahera

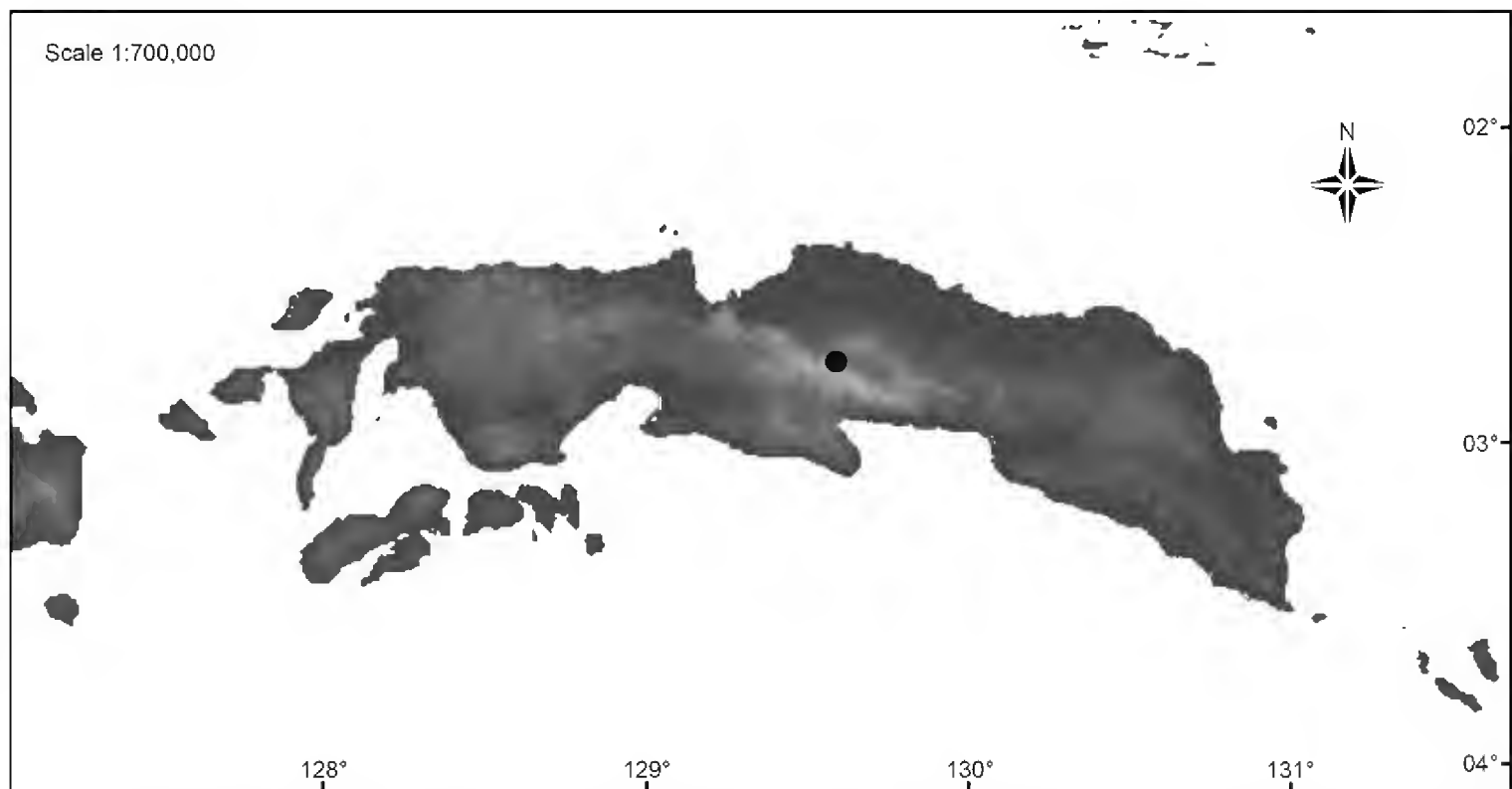
***Begonia nephrophylla* Undaharta & Ardi, sp. nov. (Section *Petermannia*)**

Species resembling *Begonia galeolepis* Ardi & D.C.Thomas in the creeping habit and the sparse to moderately dense indumentum of fleshy, branched, appressed red scales on stems, petioles and abaxial leaf lamina veins, but differs consistently by shorter petioles (3–8 cm vs 7–22 cm in *B. galeolepis*), smaller kidney-shaped leaves (5–7 × 8–11 cm vs 12.5–17.2 × 16–23.8 cm), generally shorter male flower pedicels (4–5 cm vs 4–11 cm), obovate male flower tepals (vs broadly ovate), and fewer stamens (35–40 vs 45–51). – TYPE: Originally a living collection from Indonesia, Moluccas, Sawai Village, Manusela National Park, grown on as cultivated material, vouchered and selected as type material on 18 April 2016 as *N.K.E. Undaharta 4* (holotype BO; isotypes THBB (Herbarium Hortus Botanicus Baliense, Bali Botanic Gardens), KRB, SING. (Fig. 1, 2)

Perennial, monoecious herb, stem creeping, not rhizomatous, rooting where nodes touch the substrate, up to c. 30 cm long; stems, petioles, primary and secondary veins on the abaxial leaf lamina surfaces with a sparse to moderately dense indumentum of multicellular, red scales up to 4 × 2 mm. **Stem** branched, internodes 3–4 cm, green or reddish with short white stripes or spots. **Leaves** alternate; stipules persistent, 12–15 × 5–8 mm, ovate to narrowly triangular, acuminate, setose, margin entire and sometimes slightly revolute, reddish, translucent at the margins; **petioles** c. 3–8 cm long, adaxially deeply channelled, moderately covered by red scales which form a ring at the attachment of the petiole to the lamina base; **lamina** basifixed, 5–7 × 8–11 cm, broadly ovate to suborbicular, base cordate and lobes not overlapping, apex rounded or slightly acute, margin denticulate, the teeth bristle-pointed, adaxially dark green, glabrous, prominent between the veins, abaxial surface green and sparsely hairy on the veins, primary veins 7–10, actinodromus, secondary veins brochidodromus.



**Fig. 1.** *Begonia nephrophylla* Undaharta & Ardi **A.** Growth habit in cultivation. **B.** Red scales on stem and stipules. **C.** Adaxial leaf surface. **D.** Stipules. **E.** Bracts. **F.** Abaxial leaf surface. **G.** Inflorescence. **H.** Male flower. **I.** Fruits. **J–K.** Female flower. **L.** Ovary transverse section. Scale bars: A–C, F, G = 5 cm; D, E, H–L = 1 cm. (Photos: Gede Wawan Setiadi)



**Fig. 2.** Distribution of *Begonia nephrophylla* Undaharta & Ardi. Collection sites are indicated by a circle (Manusela National Park). Specimen location information was georeferenced using the GeoNames geographical database (<http://www.geonames.org/>).

**Inflorescences** axillary, protogynous, female partial inflorescence 1–2-flowered, basal to the male partial inflorescences, peduncles c. 3 mm long; male partial inflorescences 2–3, monochasial, each monochasium with 2–4 flowers, peduncles c. 5 mm long; **bracts** ovate to elliptic, 10–20 × 7–10 mm, creamy, tinged pink, with an abaxially prominent midrib and sparse tiny red scales, apex projecting acuminate. **Male flowers:** pedicels 4–5 cm long, glabrous; **tepals** two, white or white with a pink tinge at the margin, abaxially glabrous, obovate, 14–16 × 14–15 mm; **androecium** of 35–40 stamens, yellow, filaments 1–2 mm long, slightly fused at the very base, anthers c. 1–1.5 mm long, obovate, dehiscing through unilaterally positioned slits c. 1/2 as long as the anthers. **Female flowers:** pedicel 1.8–2 cm long, sparsely hairy, red to green; **tepals** (4–)5, white tinged with pink, unequal, the four larger 20–21 × 12–18 mm, obovate, the smallest 16–17 × 3–4 mm, elliptic, abaxially glabrous; **ovary** obovoid, 10–12 × 5–6 mm (excluding the wings), green, glabrous but sometimes sparsely red hairy, locules 3, placentation axile, placentae bilamellate, wings 3, green to reddish, base rounded, apex cuneate, style basally fused, 3-branched, each stylodium bifurcate in the stigmatic region, stigmatic surface a spirally twisted papillose band, orange. Fruits borne on pedicels up to 4 cm long, capsule obovoid, up to c. 19 × 10 mm (excluding the wings), sparsely hairy, dehiscent, wing shape as for ovary. **Seeds** unknown.

**Distribution.** Endemic to Seram, Manusela National Park, locally common.

**Habitat.** Primary lowland rainforest, growing on damp soil, near a river in light shade, 19 m altitude.



*Etymology.* The specific epithet is derived from the Greek *nephros* (kidney) and *phyllum* (leaf). Refers to the leaf shape which resembles a kidney.

*Notes.* The character of a creeping stem in *Begonia* section *Petermannia* is not well represented in Asia except in a number of species in Borneo (*B. bosuangiana* S.Julia, *B. bakunensis* S.Julia, *B. benaratensis* S.Julia, *B. conipila* Irmsch. ex Kiew, *B. crockerensis* Rimi, *B. divergens* Kiew & S.Julia, *B. johariana* S.Julia & C.Y.Ling, *B. kachak* K.G.Pearce, *B. kasutensis* K.G.Pearce, *B. kiamfeii* Kiew & S.Julia, *B. kinahimiae* Rimi, *B. lucychongiana* S.Julia & Kiew) (Kiew et al., 2015; Repin et al., 2015), the Moluccas (*B. aketajawensis*, *B. holosericea*, *B. holosericeoides*, *B. manuselaensis*, *B. galeolepis*, *B. sageaensis*) (Wiriadinata, 2012; Ardi et al., 2014; Ardi & Thomas, 2015; Hughes et al., 2015; Ardhaka et al., 2016) and Sulawesi (*B. gemella* Warb. ex L.B.Sm. & Wassh., *B. heteroclinis* Miq. ex Koord. and *B. flacca* Irmsch.) (Thomas et al., 2013), but *Begonia nephrophylla* can easily be distinguished from all of these species by the moderately dense indumentum of fleshy, branched, appressed red scales on the stems, petioles and abaxial leaf lamina veins. Otherwise *Begonia nephrophylla* is morphologically similar to *B. galeolepis* from Seram except that its creeping stem never tends to be erect or semi erect, while in *B. galeolepis* it initially has a semi-erect stem which becomes creeping when older. Other characters to distinguish the two species are given in the diagnosis.

*Provisional IUCN conservation assessment.* Data Deficient (DD). *Begonia nephrophylla* is known from a single locality in a legally protected area, Manusela National Parks, where no signs of major anthropogenic disturbance were noticed. Further exploration is required to assess the species' current range.

Identification key to *Begonia* in the Moluccas  
(updated from Ardi et al., 2014)

- 1a. Plant erect ..... 2
- 1b. Plant creeping ..... 3
  
- 2a. Leaves broadly ovate; female flowers with 2–5 tepals; male flowers with 2 tepals, anther connectives not projecting at apex ..... *B. rieckei* complex
- 2b. Leaves oblong, elliptic or broadly elliptic; female flowers with 6 tepals; male flowers with 4 tepals, anther connectives projecting at apex ..... *B. aptera*
  
- 3a. Stem with branched hairs ..... 4
- 3b. Stem with red scales ..... 7
  
- 4a. Male flower with 4 tepals; leaves obovate to orbicular ..... *B. aketajawensis*
- 4b. Male flower with 2 tepals; leaves ovate or broadly ovate to suborbicular ..... 5

- 5a. Leaves densely hairy on both sides ..... *B. sageaensis*  
 5b. Leaves upper surface glabrous ..... 6
- 6a. Leaves broadly ovate to suborbicular with rounded apex; female inflorescence peduncle 2–3 mm long; ovaries densely hairy ..... *B. holosericea*  
 6b. Leaves ovate with acuminate apex; female inflorescence peduncle 1.1–3.5 cm long; ovaries sparsely hairy or glabrous ..... *B. holosericeoides*
- 7a. Stem thin with sparse, small, red, flattened scales on the stem and petioles; leaves small (4.8–7 × 3–5 cm), ovate to elliptic; male partial inflorescences 1(–2) per inflorescence ..... *B. manuselaensis*  
 7b. Stem thicker with moderately dense larger red flattened scale and petioles, larger broadly ovate or suborbicular leaves (> 7 × 5 cm); male partial inflorescences 2–3 per inflorescence ..... 8
- 8a. Leaves adaxially green to reddish, broadly ovate or suborbicular, 16–23.8 × 12.5–17.2 cm, apex acuminate; male flower pedicels 4–11 cm long, tepals broadly ovate, stamens 45–51; female flower tepals 5(–6), abaxially sparsely hairy to glabrescent, ovary wings with slightly rounded to cuneate base, apex of wings truncate ..... *B. galeolepis*  
 8b. Leaves adaxially dark green, suborbicular, 8–11 × 5–7 cm, apex shortly acute or rounded; male flower pedicels 4–5 cm long, tepals obovate, stamens 35–40; female flower tepals (4–)5, abaxially glabrous, ovary wings with rounded base, apex of wings cuneate ..... *B. nephrophylla*

ACKNOWLEDGEMENTS. We thank the *Begonia* expedition to Seram team members, I Gede Tirta, I Made Ardhaka and I Putu Suparta, the curators of A, B, BM, BO, CEB, E, K, L and SING for allowing us access to herbarium material, and Daniel Thomas and David Middleton for their comments and correcting the English.

### References

- Ardhaka, I.M., Ardi, W.H., Undaharta, N.K.E. & Tirta, I.G. (2016). A new species of *Begonia* from Manusela National Park, Seram. *Reinwardtia* 15(1): 61–64.
- Ardi, W.H. & Thomas, D.C. (2015). Studies on *Begonia* (Begoniaceae) of the Moluccas II: A new species from Seram, Indonesia. *Gard. Bull. Singapore* 67(2): 297–303.
- Ardi, W.H., Kusuma, Y.W.C., Lewis, C.E., Risna, R.R., Wiriadinata, H., Abdo, M.E. & Thomas, D.C. (2014). Studies on *Begonia* (Begoniaceae) of the Molucca Islands I: Two new species from Halmahera, Indonesia, and updated description of *Begonia holosericea*. *Reinwardtia* 14: 19–26.
- Doorenbos, J., Sosef, M.S.M. & De Wilde, J.J.F.E. (1998). The sections of *Begonia* including descriptions, keys and species lists (Studies in Begoniaceae VI). *Wageningen Agric. Univ. Pap.* 98(2): 1–266.

- Hughes, M., Moonlight, P., Jara, A. & Pullan, M. (2015). *Begonia* Resource Centre. Royal Botanic Garden Edinburgh. <http://elmer.rbge.org.uk/begonia/> (accessed on 11 Jun. 2016).
- Kiew, R., Sang, J., Repin, R. & Joffre, A.A. (2015). *A Guide to Begonias of Borneo*. 294 p. Kota Kinabalu: Natural History Publications (Borneo).
- Repin, R., Sang, J., Kiew, R. & Mujih, H. (2015). Eleven new species of *Begonia* (Begoniaceae) from the Crocker Range, Sabah, Malaysia. *Phytotaxa* 208(1): 1–20.
- Tebbitt, M.C. (2005). *Begonias: Cultivation, Identification and Natural History*. Portland: Timber Press, Inc.
- Thiers, B. (continuously updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/> (accessed on 8 Mar. 2016).
- Thomas, D.C., Ardi, W.H., Girmansyah, D. & Hughes, M. (2013). Sulawesi *Begonia* Data Portal. <http://portal.cybertaxonomy.org/flora-malesiana-prospective/> (accessed on 24 Aug. 2016).
- Wiriadinata, H. (2012). A new species of *Begonia* (Begoniaceae) from Sagea Lagoon, Weda Bay, Halmahera Island, North Moluccas, Indonesia. *Reinwardtia* 13(3): 263–270.



## *Etilingera poulsenii* and *Hornstedtia bella* (Zingiberaceae: Alpinieae), two new species from central Vietnam

J. Leong-Škorníčková<sup>1</sup>, Q.B. Nguyễn<sup>2</sup>, H.Đ. Trần<sup>3</sup> & E. Závěská<sup>4,5</sup>

<sup>1</sup>The Herbarium, Singapore Botanic Gardens,  
National Parks Board, 1 Cluny Road, Singapore 259569  
jana\_skornickova@nparks.gov.sg

<sup>2</sup>Vietnam National Museum of Nature,  
Vietnam Academy of Science and Technology,  
18 Hoàng Quốc Việt Street, Cầu Giấy, Hanoi, Vietnam

<sup>3</sup>National University, University of Science,  
Ho Chi Minh City, Vietnam

<sup>4</sup>Department of Botany, Faculty of Science, Charles University,  
Benátská 1, Prague, 12801, Czech Republic

<sup>5</sup>Institute of Botany, University of Innsbruck, Sternwartestraße 15,  
Innsbruck, 6020, Austria

**ABSTRACT.** Two new ginger species from central Vietnam, *Etilingera poulsenii* Škorníčk. and *Hornstedtia bella* Škorníčk., are described and illustrated here.

**Keywords.** Endangered, *Etilingera pavieana*, *Etilingera yunnanensis*, *Hornstedtia sanhan*

### Introduction

As a result of extensive field exploration and collection of Zingiberales in Vietnam since 2008, numerous novelties, including a new genus, have already been described (e.g. Leong-Škorníčková & Lý, 2010; Leong-Škorníčková et al., 2010, 2011, 2013, 2015a, 2015b; Leong-Škorníčková & Lru, 2013; Leong-Škorníčková & Trần, 2013). To put novelties in Indochinese Zingiberales in a wider context, an introduction to the phytogeography of the region can be found in Averyanov et al. (2003) and an introduction to the family Zingiberaceae can be found in Leong-Škorníčková & Newman (2015), as well as in some of the papers cited above.

In this paper we formally describe and illustrate two new species in Alpinieae, *Etilingera poulsenii* Škorníčk. and *Hornstedtia bella* Škorníčk., from central Vietnam. Both species were informally mentioned (through use of quotation marks) and illustrated in Leong-Škorníčková & Newman (2015) but were not validly published. The species descriptions follow the style and terminology of Poulsen (e.g. 2006, 2012) and Beentje (2012), and the preliminary conservation assessments follow the guidelines of IUCN (2012). Herbarium material (or high resolution images of specimens) from E, HN, HNL, K, P, SING, VNM, VNMN were consulted to compare the new material to the most similar species within the respective genera and to see if they had been previously collected. The herbarium acronyms follow Thiers (continuously updated).

***Etlingera poulsenii* Škorničk., sp. nov.**

Similar to *Etlingera pavieana* (Pierre ex Gagnep.) R.M.Sm., but differs in narrower leaf blades (2.5–5 cm wide versus 6–8 cm in *E. pavieana*), shorter filament (2–4 mm long versus 7–8 mm long) which is half the length of the anther or less (versus as long as or longer than the anther), and the basal lobes of the labellum overlapping and fully covering the filament (versus basal lobes of the labellum upright but not overlapping with the filament clearly visible). – TYPE: Vietnam, Kontum Province, Kon Plong District, Xã Hiếu, way to Ka Bang, 27 April 2012, *Jana Leong-Škorničková, Nguyễn Quốc Bình, Trần Hữu Đăng, Eliška Závěská JLS-1595* (holotype SING (including spirit); isotypes E, K, P, PR, VNMN (including spirit)). (Fig. 1, 2)

Large terrestrial rhizomatous herb. **Rhizome** 1 cm in diam., pubescent, scales to 4.5 cm long, delicately papery, dehiscent, glabrous, strongly aromatic with somewhat unpleasant smell of kerosene; stilt roots absent. **Leafy shoots** to 2.5 m long, arching, composed of up to 35 leaves, 20–50 cm between neighbouring leafy shoots, leafless part c. 0.8 m; base to 3 cm in diam., pale yellowish brown; sheath yellowish green, striate, not clearly cross-ribbed, glabrous, margin glabrous; **ligule** to 7–11 mm long, entire, rounded, yellowish green, glabrous, margin finely ciliate; **petiole** 3–10 mm long; **lamina** narrowly ovate, to 21–34 × 2.5–5 cm, length to width ratio 6.6–8.5, smooth, mid-green, pale beneath, glabrous, base cuneate, apex acuminate to 1.5 cm, margin ciliate in upper third. **Inflorescence** 8–11 cm long, embedded in the soil, receptacle dome-shaped, c. 8 cm long, with 19–21 flowers, 1–3 open at a time; **peduncle** 3–5 cm long, subterranean, pubescent, peduncular bracts to 3.2 × 3 cm, upper covering base of spike, cream to reddish, puberulous, margin membranous, with a few cilia near apex, subapical mucro < 1 mm; **spike** (including flowers) 6–6.5 cm long, ovoid, flowers extending 1.5 cm above the bracts, spike only including bracts 4.5–5.5 × 2.5–3 cm; **sterile bracts**: 3, lower to 3.8–4.5 × 2.5–3.6 cm, upper to 4.5–5 × 0.8–3.2 cm, ovate, red, pubescent in lower third; **fertile bracts** 4.2–4.5 × 0.9–2.2 cm, ovate, boat-shaped, red, pubescent in lower half and at apex, inner more narrowly obovate, pale red, semi-translucent; **pedicel** 2 mm long below bracteole; **bracteole** 4 cm long, pale red, with two fissures of 0.2 and 1.5 cm, pubescent in lower half and near apex, apex bilobed, lobes close together, 1.7 cm short of apex of calyx. **Flower** 6–8 cm long; **calyx** 5.5 cm long, reaching 5–6 mm beyond base of stamen and 2 mm short of apex of corolla lobes, pale pink, darker at base and apex, with three fissures of 4, 7 and 22 mm, hirsute, apex trilobed, apices pointed, close together, tufted; **floral tube** c. 4.7 cm long, pale red to red at apex, hirsute also on staminal tube, tube inside hairy in a dense band c. 5 mm wide coinciding with attachment of lobes on the outside; **corolla lobes** pinkish red, glabrous with a few hairs at apex; **dorsal corolla lobe** c. 21 × 6 mm, reaching to base of anther, elliptic, apex rounded; **lateral corolla lobes** c. 19 × 5 mm, obovate, apex rounded, with a few hairs at apex, attached at an angle to the tube, inserted 0–1.5 mm above dorsal lobe; **staminal tube** c. 11 mm long; **labellum** panduriform, to 33 × 22 mm, brilliant orange with dark red to maroon centre, glabrous, lateral lobes erect, c. 16 mm across when flattened, central lobe extending c. 25 mm beyond anther. **Stamen** c. 8 mm long (unstraightened), pinkish



**Fig. 1.** *Etlingera poulsenii* Škorničk. **A.** Habit. **B.** Detail of ligule. **C.** Inflorescence (top view). **D.** Flower (side view). **E.** Flower (front top view). **F.** Inflorescence attached to rhizome. **G.** Inflorescence and infructescence attached to rhizome. **H.** Detail of infructescence. Based on type collection *JLS-1595*. (Photos: J. Leong-Škorničková)

red, darker at apex; *filament* 2–4 × 3 mm, pubescent adaxially; *anther* c. 8 × 3.5 mm, ± parallel-sided, widest in the middle, at an angle of c. 110°, reddish pink, anther crest emarginate, incision c. 1 mm; *anther thecae* dehiscent for 6 mm in the centre, from 1.5 mm above base to 0.5 mm below apex, with a few hairs at base. **Ovary** c. 5 × 3.5 mm, ± cylindrical, widest in the middle, densely sericeous; *epigynous gland* c. 4.5 mm long, bilobed, split to base dorsally and halfway from apex on opposite side, apex lobes irregularly pointed; *style* c. 5.7 cm long, red, glabrous; *stigma* c. 2.6 mm wide, dark burgundy red, with scattered short hairs, ostiole facing forwards, flexistylous. **Infructescence** partly embedded in the soil, head c. 6 × 6 cm, irregularly globose, bracts persistent, with 4–5 fully developed and 2–4 small (possibly aborted) fruit per head; *mature fruit* c. 2 × 3 cm, rounded, slightly angular, burgundy, rusty-pubescent.

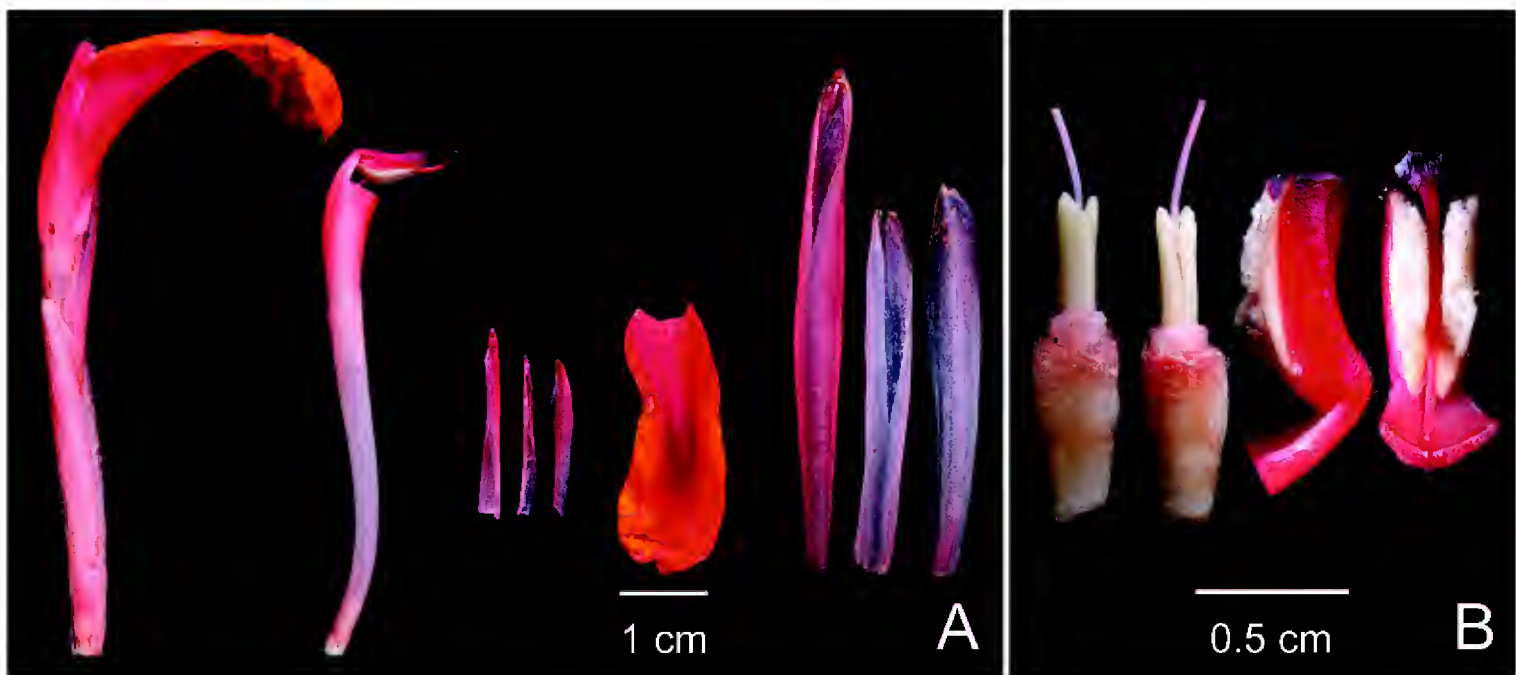
**Etymology.** We dedicate this beautiful species to Axel Dalberg Poulsen, a Danish ginger specialist focusing on the genus *Etilingera* (see e.g. Poulsen 2006, 2012).

**Distribution & provisional IUCN assessment.** So far known only from the primary forests on the border of Kontum and Gia Lai Provinces. Considering the existence of suitable habitats in adjacent areas as well as the fact that *Etilingera* species only rarely exhibit stenoendemism, we expect this taxon to be reported from more localities in the near future. Until then we propose to treat this taxon as Data Deficient.

**Ecology and phenology.** Growing in montane evergreen broad-leaved forest near streams. Flowering and fruiting observed in late April, but likely to continue over an extended period of time.

**Notes.** The plants of *Etilingera poulsenii*, particularly the rhizomes when crushed, have a very strong and somewhat unpleasant scent of kerosene. No common names or uses were reported by local guides. Based on overall morphology, *Etilingera pavieana* (Pierre ex Gagnep.) R.M.Sm., a fairly widespread species from Thailand to Vietnam, appears to be the closest ally. Plants of *Etilingera pavieana* are also strongly scented, although the scent is more pleasant with fennel undertones, making the rhizomes and the inflorescence buds a popular addition to certain dishes in Thailand. The flowers of *Etilingera pavieana* are mostly bright red, although orange-flowered individuals have also been observed. Although of similar habit, *Etilingera poulsenii* has significantly narrower leaf blades with the leaf width 2.5–5 cm (length to width ratio 6.6–8.5), while the leaf blades of *E. pavieana* on the type specimen are 6–8 cm (with length to width ratio 5.6–6) in the dried state and therefore likely to be even wider when fresh. The main differences between the two species are in the floral morphology. *Etilingera poulsenii* has a short filament 2–4 mm, which is half the length of an anther (c. 8 mm) or less, and the filament is not visible in the open flower as it is fully covered by the overlapping basal part of the labellum. As a result, the labellum appears to be obovate with a decurrent base (in top view). The stigma is dark burgundy red, with a glistening sheen. The filament in *Etilingera pavieana* is at least of the same length as the anther,





**Fig. 2.** *Etlingera poulsenii* Škorničk. **A.** Flower dissection (from left): Flower enclosed in bracteole, floral and staminal tube with stamen attached, dorsal and corolla lobes, labellum, calyx, bracteole and bract. **B.** Detail of ovary with epigynous glands (from two angles) and the stamen (side and front view). Based on type collection *JLS-1595*. (Photos: J. Leong-Škorničková)

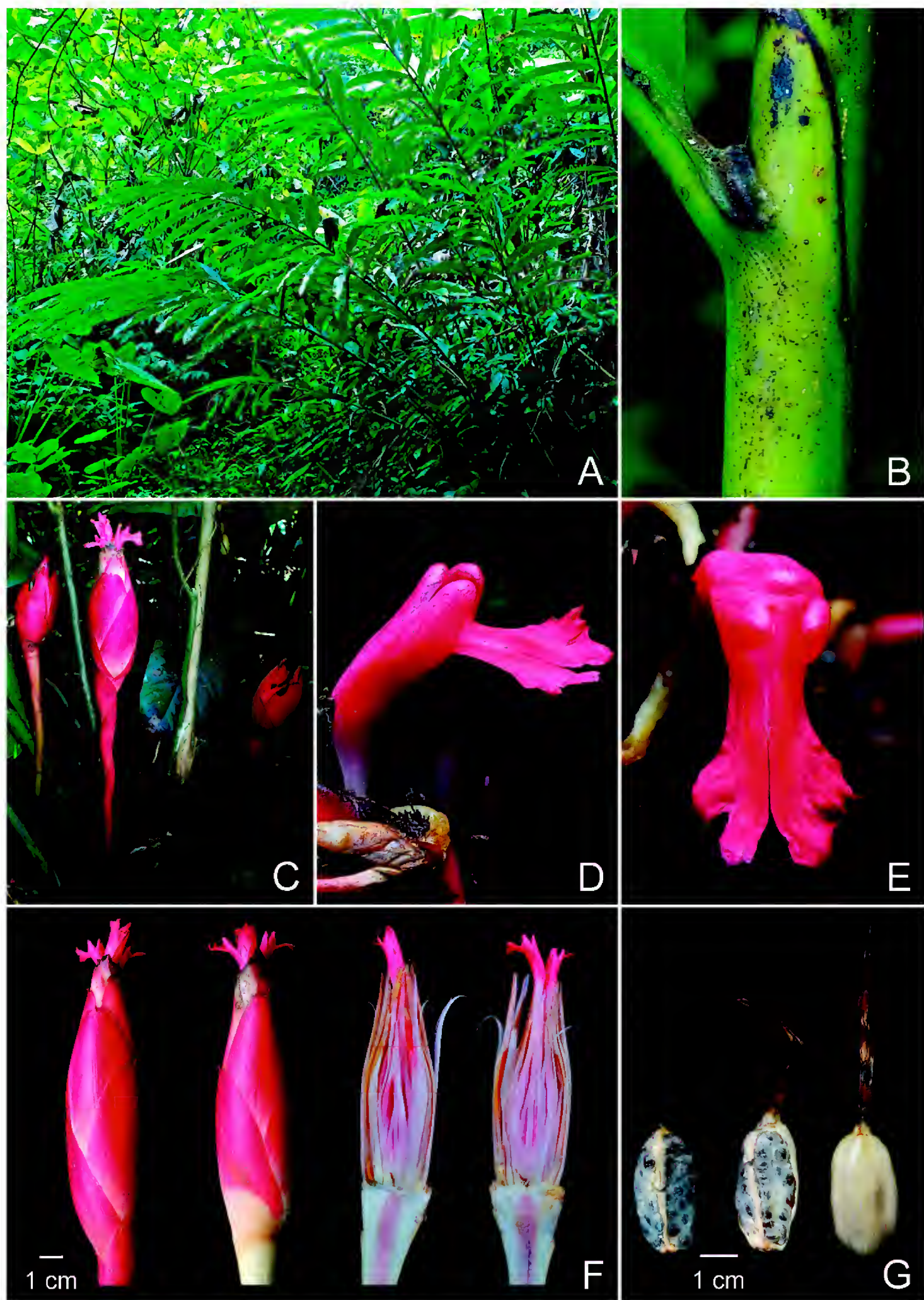
or slightly longer, and is visible in the open flower as the basal part of the labellum is not tightly overlapping and the entire labellum appears to be oblong in top view. The stigma is white or light red, but never dark burgundy red.

The flowers of *Etlingera poulsenii* are also somewhat similar to *Etlingera yunnanensis* (Wu & Senjen) R.M.Sm. by virtue of the red centre of the labellum, the basal part of the labellum fully covering the filament, and the dark burgundy red, glistening stigma. However, *Etlingera poulsenii* is a smaller species with more slender and arching leafy shoots not exceeding 2 m in height and composed of leaf blades 21–34 × 2.5–5 cm. The habit of *Etlingera yunnanensis* is more robust with more or less erect leafy shoots often reaching 3 m in height and composed of leaf blades 50–60 × 5.5–8 cm, and the labellum is invariably bright yellow with a dark red centre. For a comparison of the flowers of all three species see Leong-Škorničková & Newman (2015).

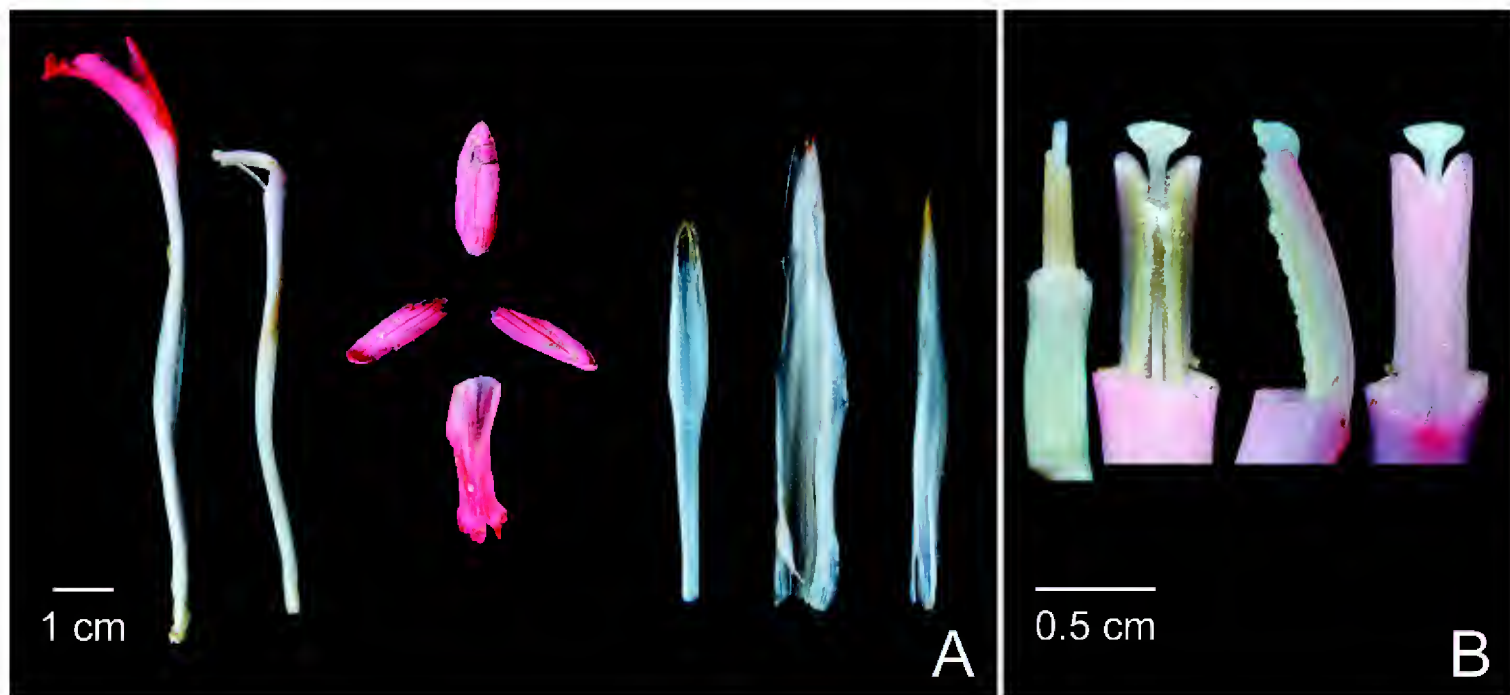
***Hornstedtia bella* Škorničk., sp. nov.**

Similar to *Hornstedtia hainanensis* T.L.Wu & S.J.Chen, but readily recognised by its prominently pedunculate inflorescences and the bright pink labellum, of which each lobe has two obscure sub-lobes. – TYPE: Vietnam, Thừa Thiên-Huế Province, A Lưới District, A Roang commune, forests around A Ka I village, alt. 554 m, 16°06'56.8" N 107°22'24.8"E, 8 June 2014, Jana Leong-Škorničková, Nguyễn Quốc Bình, Aung Thame & Paul Leong *JLS-2846* (holotype SING (including spirit); isotype E, P, VNMN (including spirit)). (Fig. 3–5)

Large terrestrial rhizomatous herb. **Rhizome** 1.5–2.5 cm in diam.; stilt roots present but not prominent. **Leafy shoots** 3–5 m long composed of up to 31 leaves, arching, 10–20 cm between neighbouring leafy shoots, leafless in basal 1/3–1/2; base swollen, to c. 3 cm in diam.; sheath green, striate, not clearly cross-ribbed, glabrous, margin glabrous; **ligule** 11–15 mm long, entire, rounded, yellowish green, glabrous, margin glabrous; **petiole** to 10 mm long; **lamina** elliptic, to 55–65 × 9–10.5 cm, length to width ratio 5.2–7.2, weakly plicate, mid to dark green, glossy, paler beneath, glabrous, base obtuse, apex acuminate to 1 cm, margin glabrous. **Inflorescence** to (25–)30–60 cm long, erect, receptacle flat, with many flowers, 1–5 open at a time; **peduncle** (15) 20–50 cm long, erect, peduncular bracts to 7 × 2.3 cm, upper covering base of spike, yellowish-green with pink tinge at base, turning pink-red toward apex, densely pubescent at base, less so at apex, margin membranous, densely ciliate, apex blunt; **spike** (including flowers) 12–13.5 cm long, fusiform, flowers extending 1.5 cm above the bracts, spike only including bracts 11–12 × c. 3 cm; **sterile bracts**: c. 18, outer to 6–8 × 2.5–4 cm, pink-red (parts exposed to light, inner bracts or parts shielded by overlapping outer bracts cream-white) densely pubescent at base (rusty golden colour in dried material) becoming sparsely pubescent to almost glabrous at apex, inner c. 8 cm long, but gradually narrower to 1.8 cm, ovate, boat-shaped, cream-white, indumentum as on outer bracts; **fertile bracts** 7–8.5 × 0.6–2.5 cm (longer and wider in outer whorls, gradually smaller and narrower towards centre of inflorescence), ovate, boat-shaped, cream-white, glabrous, semi-translucent; **pedicel** 2 mm long, **bracteole** absent. **Flower** 8–10 cm long; **calyx** 4–5.5 cm long, white, with unilateral incision c. 17 mm, softly sericeous (more towards base), apex trilobed, apices pointed, close together, tufted; **floral tube** 6–7.5 cm long, mostly white with light pink tinge at apex, externally sparsely sericeous, internally long puberulous in apical half, almost glabrous towards base; **corolla lobes** dark pink, glabrous; **dorsal corolla lobe** 20 × 7–8 mm, elliptic, apex obtuse, slightly hooded; **lateral corolla lobes** 12–13 × 5 mm, elliptic, apex obtuse, attached at an angle to the tube, **labellum** c. 25 × 5.5–9 mm, pale pink at base, bright pink-red at apex, hairy at base and centre, lateral lobes somewhat erect, c. 9 mm across when flattened, central lobe bilobed with an incision of 5–7 mm, each lobe with two obscure sub-lobes. **Stamen** 10–11 mm long, **filament** fully reduced; **anther** 10–11 × 3.5–4.5 mm, ± parallel-sided, widest at apex, angled c. 110°, connective tissue white with pale pink tinge dorsally, incision 2–3 mm, no anther crest; **anther thecae** slightly extending into floral tube, dehiscent c. 9 mm in the centre, densely hairy at margins. **Ovary** 8 × 3 mm, ± cylindrical, widest in the middle, sparsely softly villous (denser towards apex); **epigynous gland** c. 5 mm long, bilobed, enveloping the style, split to base dorsally and ventrally, apex lobes irregular, blunt; **style** white, glabrous; **stigma** c. 2.5 mm wide, white, glabrous, ostiole facing forwards, flexistylous. **Infructescence** c. 12 × 6 cm, broadly spindle-shaped, with numerous fruit developed; **fruit** an indehiscent capsule with persistent calyx, 3.5 × 1.3–1.8 cm (mature capsule only, without calyx), ellipsoid, slightly angular, cream-white to beige or with pink tinge throughout, glabrous; **seeds** irregularly globose, 2–3 mm in diam., dark brown, fully embedded in juicy sour-sweet aril.



**Fig. 3.** *Hornstedtia bella* Škorničk. **A.** Habit. **B.** Detail of ligule. **C.** Inflorescence. **D.** Flower (side view of the apical part exerted from bracts). **E.** Flower (front top view). **F.** Flowering head from outside inclusive the sterile bracts (left), and in cross-section showing the almost flat receptacle (sterile bracts were removed) **G.** Fruit and seeds. Based on collections *JLS-2846* (type) and *JLS-2828*. (Photos: J. Leong-Škorníčková)



**Fig. 4.** *Hornstedtia bella* Škorničk. **A.** Flower dissection (from left): Flower (bract and bracteole removed), ovary with floral and staminal tube and stamen attached, dorsal and corolla lobes, labellum, calyx, bract (from outer part of the inflorescence) and bract (from innermost part of the inflorescence). **B.** Detail of ovary with epigynous gland and the stamen (front, side and back view). Based on type *JLS-2846*. (Photos: J. Leong-Škorničková)

*Etymology.* We have chosen the epithet ‘bella’ as we think it is one of the most beautiful Vietnamese species (see Fig. 5).

*Distribution & provisional IUCN assessment.* Although *Hornstedtia* species are not known to exhibit stenoendemism, this rather conspicuous species has been seen and collected only from two locations in A Lưới district (unprotected areas), Thừa Thiên-Huế Province and once each from Quảng Nam and Kontum provinces (both within Nature Reserves). We have not located any historical specimens of this species in the numerous herbaria we have studied. Only the recent specimens and photographic records, which are listed below, are known. Although Averyanov *et al.* state on the label of their collection (*HAL-7547*) that it is locally common, from our surveys and from interviewing local people almost a decade later, it does not appear to be so. No uses were reported, but the damage to the existing primary vegetation is considerable and rapidly expanding outside of the Nature Reserves. The current extent of occurrence (EOO) has been estimated at about 1250 km<sup>2</sup> with only four populations known and we, therefore, propose that this species be treated as Endangered (EN B1ab(iii)).

*Ecology and phenology.* Growing in montane evergreen broad-leaved forest near streams and other wet locations, on shale and granite. It has also been seen in secondary closed broad-leaved forest and disturbed forest mixed with bamboos, but only in locations with adequate humidity. Flowering has been observed from April to early June. The first ripe fruit were observed in early June but fruiting is likely to continue till late July or even early August.



**Fig. 5.** *Hornstedtia bella* Škorničk. **A.** Detail of inflorescences (top view). **B.** Markedly pedunculate inflorescences and infructescences. **C.** Detail of inflorescences and an infructescence (side view). From Averyanov *et al.* HAL-7547. (Photos: L. Averyanov)

*Additional specimens examined.* VIETNAM: **Thừa Thiên-Huế:** A Lưới District, Hong Kim Municipality, proximity of A Nor waterfall, alt. 663 m, 16°18'04.3"N 107°13'07.0"E, 7 Jun 2014, *Jana Leong-Škorničková, Nguyễn Quốc Bình, Aung Thame & Paul Leong* JLS-2828 (E, P, SING, VNMN). **Kontum:** Đắk Glei District, about 15-18 km to NW of Đắk Glei town, between Mang Khen (Dak Che) and Dak Poko villages, near Laos boundary, 1250–1450 m, 22 November 1995, *Averyanov, L. et al.* VH 1914 (MO). **Quảng Nam:** Nam Giang Distr., Sông Thanh Nature Reserve, 18 Jul 2009, *Vũ Xuân Phuong et al.* TVC-360 (HN).

*Additional photographic records seen.* VIETNAM: **Thừa Thiên-Huế:** A Lưới Distr., Hong Kim Municipality, Dut village, about 3 km to NE from point 16°17'54"N 107°12'41"E near A Nor waterfall, c. 700–800 m a.s.l., 27 Apr 2005, *Averyanov L., Loc P.K., Thao, T.V. & Vinh, N.T.* HAL-7547 (flowering and fruiting material seen). **Kontum:** Đắk Glei District, Ngọc Linh Nature Reserve (fruiting material seen).

*Notes.* The existence of this beautiful species was brought to our attention by Prof. Leonid Averyanov who showed us his photographs. Although it was clearly a new species, the lack of spirit material discouraged us from describing it until we could collect it ourselves almost a decade later.

*Hornstedtia bella* is readily distinguished from the only other *Hornstedtia* species in Vietnam, *H. sanhan* M.F.Newman (Newman, 1995), by its prominently pedunculate inflorescences and the bright pink labellum, each lobe of which has two further sub-lobes, resulting in a 4-lobed appearance. Although the seeds are like those of *Hornstedtia sanhan*, fully embedded in a tasty sour-sweet juicy aril, the local people do not seem to consume them. The species might have some horticultural potential for landscaping. Its flowers are short-lived and without them, the bracts are not particularly beautiful so there is little prospect for the cut-flower industry.

**ACKNOWLEDGEMENTS.** We thank the Asian Zingiberaceae Information Centre at Singapore Botanic Gardens and the Zingiberaceae Resource Centre at the Royal Botanic Garden Edinburgh (<http://elmer.rbge.org.uk/ZRC/>) for providing protologues and other references. We thank the Agriculture Department and other authorities of Kontum and Thừa Thiên-Huế provinces for granting us permission and providing support for our fieldwork. We thank Dr Leonid Averyanov for bringing the existence of *Hornstedtia bella* to our attention and for sharing with us his images and locality data. We also thank Maxim Nuraliev for sharing his photographic records and localities of very many Vietnamese Zingiberaceae including *Etilingera pavieana*. We thank Dr Axel D. Poulsen for useful discussion of the two new species as well as his guidance for preparing the descriptions to capture all the important characters for these genera. Ms Anna Pozarowska, a volunteer of Singapore Botanic Gardens, is thanked for collating the colour plates in Fig. 1–4. Mr Aung Thame and Mr Paul K.F. Leong (Singapore Botanic Gardens) are thanked for their assistance in the field. We thank Assoc. Prof. Dr Nguyễn Trung Minh, Dr Vũ Văn Liên and Prof. Lưu Đàm Cư from the Vietnam National Museum of Nature for their support of our collaborative research. The research of the first author is supported by the National Parks Board, Singapore and the Czech Science Foundation, GAČR (Grant No. P506/14/13541S). We thank the two reviewers and the editor for their constructive comments and language improvements of this paper.

## References

- Averyanov, L.V., Phan, K.L., Nguyen, T.H. & Harder, D.K. (2003). Phytogeographic review of Vietnam and adjacent areas of Eastern Indochina. *Komarovia* 3: 1–83.
- Beentje, H. (2012). *The Kew Plant Glossary, an illustrated dictionary of plant terms* (revised edition). Royal Botanic Gardens, Kew: Kew Publishing.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. Switzerland, Gland and UK, Cambridge: IUCN.
- Leong-Škorničková, J. & Luu, H.T. (2013). *Curcuma leonidii*, a new species from southern Vietnam. *Phytotaxa* 126 (1): 37–42.
- Leong-Škorničková, J. & Lý, N.S. (2010). *Curcuma pambrosima* sp. nov. (Zingiberaceae) from central Vietnam. *Nord. J. Bot.* 28: 652–655.
- Leong-Škorničková, J. & Newman, M.F. (2015). *Gingers of Cambodia, Laos and Vietnam*. Singapore: Singapore Botanic Gardens, National Parks Board, in association with Royal Botanic Garden Edinburgh and Pha Tad Ke Botanical Garden.
- Leong-Škorničková, J. & Trần, H.Đ. (2013). Two new species of *Curcuma* subgen. *Ecomata* (Zingiberaceae) from southern Vietnam. *Gard. Bull. Singapore* 65: 169–180.
- Leong-Škorničková, J., Lý, N.S. & Nguyễn, Q.B. (2015a). *Curcuma arida* and *C. sahuynhensis*, two new species from subgenus *Ecomata* (Zingiberaceae) from Vietnam. *Phytotaxa* 192 (3): 181–189.
- Leong-Škorničková, J., Šída, O. & Trần, H.Đ. (2013). *Curcuma pygmaea* sp. nov. (Zingiberaceae) from Vietnam and notes on the two related species *C. parviflora* and *C. thorelii*. *Nord. J. Bot.* 31: 639–647.
- Leong-Škorničková, J., Trần, H.Đ. & Newman, M.F. (2010). *Curcuma vitellina* (Zingiberaceae), a new species from Vietnam. *Gard. Bull. Singapore* 62: 111–117.
- Leong-Škorničková, J., Lý, N.S., Poulsen, A.D., Tosh, J. & Forrest, A. (2011). *Newmania*: a new ginger genus from central Vietnam. *Taxon* 60: 1386–1396.
- Leong-Škorničková, J., Nguyễn, Q.B., Trần, H.Đ., Šída, O., Rybková, R. & Truong B.V. (2015b). Nine new *Zingiber* species (Zingiberaceae) from Vietnam. *Phytotaxa* 219(3): 201–220.
- Newman, M.F. (1995). A new species of *Hornstedtia* (Zingiberaceae) from Vietnam. *Kew Bull.* 50: 125–127.
- Poulsen, A.D. (2006). *Etilingera of Borneo*. Kota Kinabalu: Natural History Publications (Borneo).
- Poulsen, A.D. (2012). *Etilingera of Sulawesi*. Kota Kinabalu: Natural History Publications (Borneo).
- Thiers, B. (continuously updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/> (accessed on 8 Mar. 2016).





## The genus *Boesenbergia* (Zingiberaceae) in Myanmar with two new records

J.D. Mood<sup>1</sup>, N. Tanaka<sup>2</sup>, M.M. Aung<sup>3</sup> & J. Murata<sup>4</sup>

<sup>1</sup>Lyon Arboretum, University of Hawaii, 3860 Manoa Road,  
Honolulu, HI 96822, USA

<sup>2</sup>Department of Botany, National Museum of Nature and Science,  
Amakubo 4-1-1, Ibaraki 305-0005, Japan

<sup>3</sup>Forest Research Institute, Forest Department, Ministry of Natural Resources  
and Environmental Conservation, Yezin, Nay Pyi Taw, Myanmar

<sup>4</sup>Botanical Gardens, Graduate School of Sciences, the University of Tokyo, 3-7-1,  
Hakusan, Bunkyo-ku, Tokyo 112-0001, Japan

**ABSTRACT.** The taxonomic history of *Boesenbergia* Kuntze (Zingiberaceae) in Myanmar is reviewed. Based on specimen records eight species are currently confirmed as occurring in Myanmar. These include two new records, *Boesenbergia albomaculata* S.Q.Tong and *B. kerrii* Mood, L.M.Prince & Triboun. Two previously listed species, *Boesenbergia plicata* (Ridl.) Holttum and *B. thorelii* (Gagnep.) Loes., are not considered here due to lack of specimens originating in Myanmar. A key to the species is provided with a description of each based on living material.

**Keywords.** China, *Gastrochilus*, Lao P.D.R., Malaysia, Thailand

### Introduction

The genus *Boesenbergia* Kuntze (Zingiberaceae), first described under the name *Gastrochilus* Wall. (Wallich, 1829), has its taxonomic origins in Myanmar with the description of two species, *B. longiflora* (Wall.) Kuntze and *B. pulcherrima* (Wall.) Kuntze. These were collected from the Rangoon area (Yangon) during an expedition by Nathaniel Wallich and his collector, William Gomez, in 1826. At the time, Wallich's initiative to name a new genus was a bold step forward as some botanists of the day, such as William Roxburgh, might well have classified these new taxa as *Alpinia* L. Initially, Wallich did follow this thinking when he annotated his specimens as "*Alpinia bicristata* no. 131" [*G. pulcherrima*, Wallich 6588 (K-W)] and "*Alpinia? calceolaris*" [*G. longiflora*, Wallich 6589 (K-W)]. In his circumscription of the new genus (Wallich, 1829) he considered it to be "intermediate" between *Alpinia* and *Kaempferia*. Today, molecular phylogenetic data shows that *Alpinia* is in a different evolutionary lineage, while *Kaempferia* has a close affinity to *Boesenbergia* and is in the same tribe, Zingibereae (Kress et al., 2002).

A year after these first discoveries, Gomez found yet another *Boesenbergia* in the Tavoy area (Tenasserim Division), south of Rangoon. Wallich never described this specimen but did include it in Wallich (1832) as *Gastrochilus parvula* Wall. [*Gomez in*

Wallich 6590 (K-W)]. Nearly 60 years later, it was finally described by Baker (1890) in the *Flora of British India* under Wallich's name, but soon thereafter was changed to *Boesenbergia parvula* (Wall. ex Baker) Kuntze (Kuntze, 1891).

The first mention of *Boesenbergia* in a checklist of the plants of Myanmar was published by Lace (1912) with later revisions by Rodger (1922), Hundley & U Chit Ko Ko (1961), Hundley (1987) and Kress et al. (2003). This last compilation was based on original work plus collections in Myanmar by Kress and staff of the Smithsonian Institution in 1996–2004. Six species of *Boesenbergia* were listed: *B. longiflora* (under *Curcumorpha longiflora* (Wall.) Rao & Verma), *B. parvula*, *B. plicata* (Ridl.) Holttum, *B. pulcherrima*, *B. rotunda* (L.) Mansf., and *B. thorelii* (Gagnep.) Loes.

During one of the Smithsonian expeditions in 2002, a *Boesenbergia* taxon was found in Kachin State near the Indian border at c. 200 m (Kress, W.J. et al. 02-7056 & 02-7065 (US)). Living plants of these grown at the Smithsonian Greenhouses (GH2000-061 & GH2000-231) were later identified by the first author as *Boesenbergia albomaculata* S.Q.Tong. Three years later this species was found again, this time in the Hukaung Valley Tiger Reserve near Shingbuiyang, Kachin State (Murata, J. et al. 20050595K (TNS, TI)). Living plants were accessioned and grown to flowering at the Botanical Gardens, The University of Tokyo.

In 2013 three new species were described from Thailand (Mood et al., 2013): *Boesenbergia kingii* Mood & L.M.Prince, *B. maxwellii* Mood, L.M.Prince & Triboun, and *B. kerrii* Mood, L.M.Prince & Triboun. In the paper, specimens and living plants of the first two were also documented for Myanmar, while the third species was found by the second author in the Tanintharyi Region of Myanmar in 2015.

In order to verify the current checklist of *Boesenbergia* species (Kress et al., 2003) and document their representative specimens, the following herbaria were checked: AAU, ASSAM, BK, BKF, C, CAL, E, K, L, MBK, P, RAF, RANG, SING, TI, TNS, and US (Thiers, continuously updated). No specimens from Myanmar could be found for either *Boesenbergia plicata* or *B. thorelii*. The former is a robust plant found south of the Isthmus of Kra in the southern provinces of Thailand and also Peninsular Malaysia. It occurs in wet forests on non-calcareous soils. Since similar habitats occur in Tanintharyi Region, it might eventually be found there. The latter species is not likely to occur in Myanmar, as it is a deciduous forest species found on sandstone from the drier, eastern provinces of Thailand and the adjoining western areas of the Lao P.D.R. As the morphology of *Boesenbergia thorelii* is very similar to *B. pulcherrima*, it is most likely that a specimen of this was mistaken for *B. thorelii*. Consequently, *Boesenbergia plicata* and *B. thorelii* are excluded here from further consideration.

The presence of *Boesenbergia rotunda* in Myanmar is well documented via numerous specimens, old and new. Its morphology can vary considerably between populations. It is quite common naturally and also in cultivation.

The discoveries of *Boesenbergia albomaculata* (Kress, W.J. et al. 02-7065 (US); Murata, J. et al. 20050595 (TNS, TI)) and *B. kerrii* (Tanaka, N. et al. 141 (TNS, RAF)) constitute two new records for Myanmar, bringing the total number of *Boesenbergia* species to eight based on verified specimens. These are enumerated

below with a dichotomous key, individual descriptions based primarily on living plants, and photography.

Key to *Boesenbergia* species in Myanmar

- 1a. Inflorescence radical ..... 2
- 1b. Inflorescence arising on top of a leafy shoot ..... 5
  
- 2a. Labellum various shades of yellow with red maculate or streaked patterns ..... 3
- 2b. Labellum pure white with either red or red and violet patterns ..... 4
  
- 3a. Floral tube 12–14 cm long, labellum 3.8–4 cm long ..... 2. *B. kerrii*
- 3b. Floral tube to 10 cm long, labellum 2.2–2.5 cm long ..... 4. *B. longiflora*
  
- 4a. Rhizomes running, pseudostems well-spaced ..... 3. *B. kingii*
- 4b. Rhizomes non-running, pseudostems tufted ..... 5. *B. maxwellii*
  
- 5a. Stems branched ..... 6. *B. parvula*
- 5b. Stems unbranched ..... 6
  
- 6a. Inflorescence at the terminus of a c. 50 cm stem ..... 7. *B. pulcherrima*
- 6b. Inflorescence not as above ..... 7
  
- 7a. Inflorescence flabellate to 8 cm long, anther curved, crested ..... 8. *B. rotunda*
- 7b. Inflorescence oblong or oblanceolate, to 29 cm, anther straight, uncrested .....  
 ..... 1. *B. albomaculata*

**1. *Boesenbergia albomaculata*** S.Q.Tong, Acta Phytotax. Sin. 24: 323 (1986). –TYPE: China, Yunnan, November 1984, Tong, S.Q. & Liao, W.D. 24852 (holotype HITBC!). (Fig. 1A–D, 2A–B)

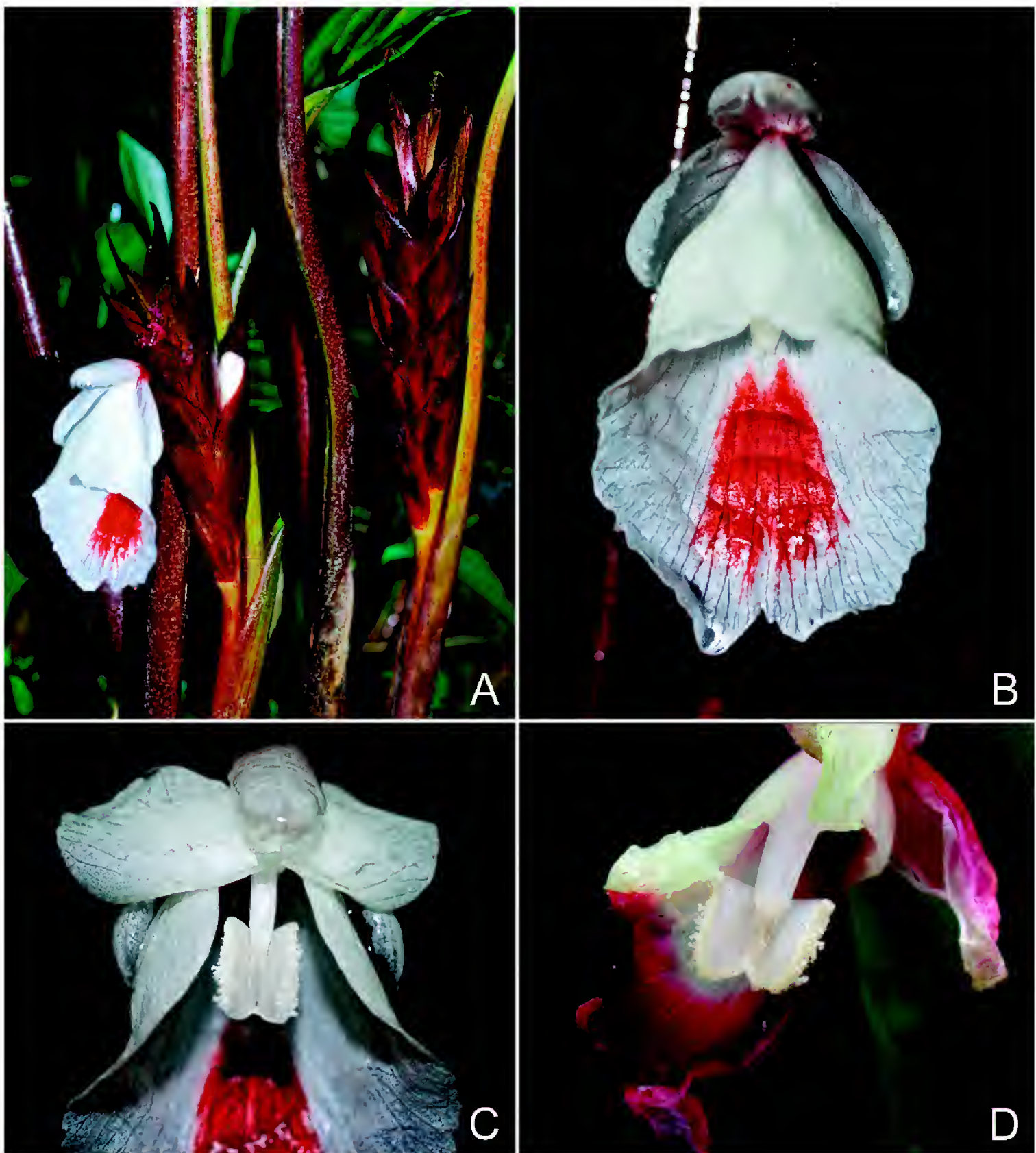
**Evergreen perennial herb** to 70 cm tall. **Rhizome** elongate, c. 7–8 cm long, 1.5–2 cm wide, externally brown, internally white, without tuberous roots. **Stem** erect, up to 24 cm tall, composed of 1–3 leaf sheaths; *leafless sheaths* 1–2 at the base, longitudinally ridged, red or green, glabrous, margin membranous, translucent. **Leaves** 1–2; *leaf sheaths* 2–4, red or green, glabrous; *ligule* slightly bilobed, lobes an extension of the membranous margin, white, glabrous; *petiole* 13–20 cm, deeply channelled, green or red, glabrous; *lamina* ovate, sometimes elliptic, 20–26 × 9–16 cm, adaxially dark green, glabrous, abaxially lighter green, sometimes reddish, especially on young leaves, glabrous, base rounded, truncate or slightly cordate, rarely cuneate, apex acute to acuminate. **Inflorescence** terminal, to 29 cm long, exerted from the leaf sheaths; *peduncle* 5–15 cm long, light green, reddish or white, glabrous, basal sheaths 1–2,

green or reddish green, glabrous; *spike* oblong to oblanceolate, 7–12 cm long, c. 2 cm wide; *bracts* 8–12, distichous, ovate to lanceolate (flattened), to 5 cm long, to 2.5 cm wide, green or red, apex falsely pungent to acute, tightly appressed or forming a pouch, rachis covered; *bracteole* tubular, lanceolate (flattened), open to the base, to 2.5 × 1.5 cm, reddish, translucent, glabrous, apex bidentate. **Flowers** to 6 cm long; *calyx* tubular, to 7 mm long, 5 mm wide (opened, flattened), red tinged or greenish, mostly translucent, glabrous, apex bifid; *floral tube* to 4 cm long, to 3 mm wide at the base, red, white, or both, externally and internally glabrous; *dorsal corolla lobe* oblong, to 2.2 cm long, to 1.2 cm wide, pink or white, glabrous, margins involute, apex sometimes emarginate, *lateral corolla lobes* oblong, to 2.4 cm long, to 1 cm wide, pink or white, glabrous, margins involute; *androecial cup* to 1 cm long, to 8 mm diam. at the top, oriented 90° to the floral tube, white, throat mostly glabrous; *labellum* saccate, orbicular, to 4 cm long, to 3.8 cm wide (when flattened), colour either rosy-red from the throat spreading outwards to the margins/apex, with some interior white patches and the exterior sometimes covered with glandular hairs, or colour overall white with dark red throat and centre with lighter red markings, externally with few glandular hairs, internally glabrous, margin entire, revolute at the margins, crisped, crenulate or slightly wavy, apex emarginate; *lateral staminodes* obovate, to 2 × 1.5 cm, white, dorsal surface glabrous or with numerous glandular hairs, ventral surface glabrous, apex rounded, revolute. **Stamen** to 1.7 cm long, *filament* to 8 mm long, 1.7–1.8 mm wide at the base, white, few glandular hairs; *anther* 8–9 × c. 3.5 mm, thecae c. 7 × 2 mm each, white, dehiscent for full length, axially rotating 180° at maturity. **Ovary** ellipsoid, c. 5 mm long, c. 4 mm wide, white, glabrous; *style* filiform, white, glabrous, *stigma* funnel-shaped with 2 opposite teeth on the margin, white, ostiole non-ciliate, sticky liquid produced at maturity; *epigynous glands* 2, linear, c. 5 mm long, light yellow. **Fruit** ellipsoid, green when young. [Composite description using: Tong (1986), living plants of *Murata, J. et al.* 20050595, and *Kress, W.J. et al.* 02-7056].

*Distribution.* China, Myanmar.

*Ecology & phenology.* Found in subtropical evergreen forests with high seasonal rainfall. Photographs of ex situ living collections show flowering in December-January and May-August. This species has a two-day flower. On the first day the anther thecae are held together, clasping the style and stigma. Soon after the flower opens, the thecae dehisce along their full length, dropping pollen onto the labellum. On the second day, the thecae begin to rotate radially, reaching c. 180° from their original position. This action releases the style, allowing the stigma to move downward from the anther. Soon afterwards a viscous drop appears from the ostiole increasing the opportunity for pollen adhesion. Later in the second day, the flower closes, but usually remains attached into the third day when it drops.

*Additional specimens examined.* CHINA: **Yunnan:** Jiedaocun, 26°44'N 97°33'E, 240 m asl, 4 Nov 1974, *Tao, G.D.* 13163 (HITBC!); Xishuangbanna, cultivated, 25 Nov 2000, *Kress, W.J. et al.* 00-6815 (US!).



**Fig. 1.** *Boesenbergia albomaculata* S.Q. Tong. **A, B.** Inflorescence and flower. **C.** Second-day flower showing rotated thecae. **D.** Second-day flower showing rotated thecae. A–C from Murata, J. et al. 20050595; D from Kress, J.W. 02-7056. (Photos: A–C, J. Mood; D, L.E. Brothers, Dept. of Botany, © Smithsonian Institution)

MYANMAR. **Kachin State:** Tawa Hka (River), 5 km from Shin Bway Yang toward Pansaung Pass (Indian Border), 26°43'25"–33"N 96°11'50"–55"E, alt. 200–210 m, 6 Dec 2005, Murata, J. et al. 20050595 (TI, TNS!); Myitkyina Township, 240 m, 24 Feb 2002, Kress, W.J. et al. 02-7056 (US!), ibidem, Kress, W.J. et al. 02-7065 (US!).

*Notes.* Currently, this species is only documented in Myanmar from the northwest area of Kachin State with one collection near Shin Bway Yang (Murata, J. et al. 20050595) and another in Myitkyina Township (Kress, W.J. et al. 02-7056, 02-7065). These sites are c. 180 km apart and both have an evergreen forest ecology. The type of the species (Tong, S.Q. & Liao, W.D. 24852) was collected c. 250 km from the Murata collection to the southeast in Yunnan Province on the China/Myanmar border in similar forest, as was an earlier specimen in 1974 (Tao, G.D. 13163). More recently (c. 1999) a living collection was made near Yingjiang, Yunnan, c. 30 km east of the type locality. It was planted at Xishuangbanna Botanical Garden (XTBG), Yunnan, but with no accession number.

When the living collections mentioned above are compared to the protologue (Tong, 1986), they are readily identified as *Boesenbergia albomaculata*. The diagnostic characters include the overall habit which is that the plant is tall and upright with numerous 1–3-leaved elements; a large, thick, ovate leaf; a long exserted, terminal, oblong-shaped inflorescence with distichous bracts; and a flower with an androecial cup. There are, though, several characters which are variable, such as bract/labellum colouration and the indumentum on the flowers. Briefly, the Murata collection has red bracts, a labellum pure white with a red throat and a single red patch near the apex and wavy margins. The labellum and lateral staminodes are mostly glabrous with only a few glandular hairs. In contrast, the Kress/XTBG collections have green bracts, labellum rosy-red (dark pink) with white near the base, crenulate margins, and an exterior densely covered in glandular hairs. The protologue details red bracts and a labellum coloured similar to the Kress/XTBG collections, but with no mention of glandular hairs.

**2. *Boesenbergia kerrii*** Mood, L.M.Prince & Triboun, Gard. Bull. Singapore 65: 64, t. 8, 9, 17, 19B (2013). – TYPE: Thailand, Tak Province, 1 November 2012, Mood, J. & Triboun, P. 12P170 (holotype BK!). (Fig. 2C–D)

**Deciduous herb** to c. 1.2 m tall. **Rhizome** globular, c. 1 cm diam., externally red, pink or light tan, internally light yellow to white; many, miniature rhizomes at the base of the stem, c. 5–10 mm long, pink turning red, easily detached; **roots** fleshy, few to numerous, c. 12 × 0.5–0.8 cm, tapering to a point, apex rarely expanded, externally and internally white, few fibrous roots, c. 1 cm long, white, thin. **Stem** to c. 4 cm long, c. 0.7 cm diam., white, glabrous, covered by 5–6 leaf sheaths forming a pseudostem, c. 30 cm long; **leafless sheaths** 1–2, green. **Leaves** 5–8; **leaf sheaths** to c. 44 cm long, green or reddish, glabrous; **ligule** bilobed, to c. 2 mm, lobes an extension of the hyaline margin, green, glabrous; **petiole** 9–27 cm long, deeply channelled, green, glabrous; **lamina** elliptic or ovate, 41–61 × 20–21 cm, base rounded to cordate, sometimes oblique, apex acute to long acuminate, adaxially dark green, glabrous, abaxially lighter green, slightly pubescent or glabrous. **Inflorescence** radical, 3–6 or more per stem, 3–6 flowers each; **peduncle** 1–4 cm long, white, glabrous, basal sheaths 1–2, pink and white, covered with short hairs; **spike** horn-shaped, 5–12 cm long, 1–2 cm diam.;



**Fig. 2.** **A, B.** *Boesenbergia albomaculata* S.Q. Tong. **C, D.** *Boesenbergia kerrii* Mood, L.M. Prince, & Triboun. A from Kress, J.W. 02-7056; B from Kress, J.W. 00-6815; C & D from Mood, J. & Triboun, P. 12P170. (Photos: A & B, L.E. Brothers, Dept. of Botany, © Smithsonian Institution; C & D, J. Mood)

*bracts* 4–6, cymbiform, distichous, 5–6 cm long, white (below ground), green and red (above ground), apex curved; *bracteole* lanceolate, c. 5 × 0.5 cm, white, translucent, glabrous. *Flowers* c. 16 cm long; *calyx* tubular, 20 × 5 mm, white, translucent, apex bidentate; *floral tube* 12–14 cm long, c. 3 mm diam., white, glabrous; *corolla lobes* linear to lanceolate, c. 2 × 0.5 cm, white to light yellow, mostly glabrous, margins involute; *androecial cup* 4–5 mm long, oriented 90° to the floral tube, throat glabrous; *labellum* saccate, semi-orbicular, 3.8–4 × 2.2 cm, light yellow, throat centre orange-red, maculate with yellow showing through as dots, c. 5 mm wide at base, broadening toward the margins, ending c. 10 mm short of the apex, then dark red streaks to the apex, margin entire, revolute on the sides, apex shortly to deeply bilobed, lobes 2–8 mm long, slightly wavy; *lateral staminodes* obovate, c. 1.3 × 1 cm, light yellow, apex rounded, revolute, margin wavy, dorsal surface with few glandular hairs; *Stamen* c. 1.1 cm long, scattered glandular hairs full length, apex slightly bilobed, *filament* 2 × 2 mm, light yellow; *anther* c. 9 × 3 mm (first day), c. 6 mm wide (second day), *thecae*

c.  $9 \times 1$  mm each, light yellow, dehiscent along the edge for full length, anther crest absent. **Ovary** cylindrical, c.  $8 \times 4$  mm, white, glabrous; **style** filiform, c. 16 cm long, yellowish-white, glabrous; **stigma** semi-spherical, ostiole round, non-ciliate, exuding a sticky liquid on the second day; **epigynous glands** 2, c. 5 mm long, light yellow. **Fruit** not seen.

*Distribution.* Myanmar, Thailand.

*Ecology & phenology.* Semi-deciduous forest on or around limestone outcrops. Flowering from June to October with a two-day flowering cycle for each flower.

*Additional Myanmar specimens examined.* **Tanintharyi Region:** Mainmapan, Taninthayi Reserved Forest, Yephyu Township,  $14^{\circ}38'19.18''\text{N}$   $98^{\circ}11'44.27''\text{E}$ , 160 m asl, 31 Jul 2015, Tanaka, N. et al. 141 (RAF, TNS!).

*Notes.* *Boesenbergia kerrii* is similar to *B. longiflora*, but the former has a more exerted, longer floral tube, broader, longer lip with a truncate apex, and a different labellum colour pattern. When the currently known habitats of each are compared, *Boesenbergia kerrii* is found only on or around limestone, while the type of *B. longiflora* and the specimen Kress, W.J. 03-7305 (US) were collected on sandstone or shale derived soils.

**3. *Boesenbergia kingii*** Mood & L.M.Prince, Gard. Bull. Singapore 65: 76, t. 14, 15, 18, 19E (2013). – TYPE: Thailand, Kanchanaburi Province, 1 November 2012, Mood, J. & Vatcharakorn, P. 12P173 (holotype BK!). (Fig. 3A–B)

**Deciduous herb** to c. 1.2 m tall. **Rhizomes** numerous, horizontal runners, variable in length, 0.5–1.5 cm diam., multiple nodes, externally pink or red when young, orange or red when mature, internally yellow to orange; **roots** few, c. 6 cm long, 3 mm diam., exterior orange or white, fibrous roots few, c. 5 mm long, white. **Stem** to 1 cm long, 4 mm diam., white, glabrous, covered by 3–7 leaf sheaths forming a pseudostem, c. 30 cm long; **leafless sheaths** 1–2, reddish, c. 4 cm long, ribbed. **Leaves** 3–7; **leaf sheaths** to c. 40 cm long, green or reddish, glabrous; **ligule** bilobed, c. 4 mm long, lobes triangular, greenish, glabrous; **petiole** to c.  $20 \times 1$  cm, deeply channelled, green or red, glabrous; **lamina** elliptic  $40\text{--}45 \times 15\text{--}16$  cm, base rounded to cordate, apex acute to attenuate, adaxially dark green, glabrous, abaxially lighter green, red or purple, glabrous or slightly pubescent. **Inflorescence** radical, 3–10 per stem, 4–5 flowers each; **peduncle**  $1\text{--}3 \times 0.5\text{--}1$  cm, white or pink, glabrous, basal sheaths 1–2,  $4\text{--}6 \times 1.5\text{--}2$  cm, red; **spike** cylindrical, slightly asymmetrical, 11–14 cm long, 1–1.5 cm diam.; **bracts** 4–5, distichous, linear,  $6\text{--}11 \times 1.5\text{--}2$  cm, veined, white, green or red, glabrous; **bracteole** lanceolate,  $5\text{--}6 \times 0.5$  cm, white, translucent, glabrous, apex bidentate. **Flowers** 14–15(–20) cm long; **calyx** 2–2.3 cm long, 5 mm diam., white, translucent, apex tridentate; **floral tube** 10–15 cm long, 4 mm diam., white, tinged





**Fig. 3.** A, B. *Boesenbergia kingii* Mood & L.M. Prince. C, D. *Boesenbergia longiflora* (Wall.) Kuntze. A & B from Mood, J. & Vatcharakorn, P. 12P173; C & D from Kress, W.J. 03-7305. (Photos: J. Mood)

or striped pink, glabrous; *dorsal corolla lobe* oblong, 3.8–4 × 1.2 cm, creamy-white, glabrous, margins involute, *lateral corolla lobes* oblong, 3.5–4 × 1.1–1.4 cm, creamy-white, glabrous; *androecial cup* 10–12 mm long, oriented 45° to the floral tube, throat glabrous; *labellum* slightly saccate, broadly oval, 5–6 × 2.5–2.7 cm, white to creamy-white, throat centre bright red, maculate with white showing through as dots, colour broadening outward to c. 8 mm short of the apex, margin wavy, wrinkled, apex entire, abaxially with few glandular hairs; *lateral staminodes* obovate, c. 2.5 × 1.5 cm, creamy-white, abaxially with few glandular hairs, apex revolute. **Stamen** c. 1.2 cm long, glabrous; *filament* 3–4 × 2–3 mm, white, glabrous; *anther* 8–9 × 3 mm (first day), c. 8–9 × 5 mm wide (second day), thecae 9 × 1 mm each, white, dehiscent along the edge for full length, anther crest absent. **Ovary** cylindrical, c. 7 × 3 mm, white, glabrous; *style filiform*; *stigma* elongate, ostiole rectangular, non-ciliate, exuding a sticky liquid on the second day; *epigynous glands* 2, linear, c. 8 mm long, white. **Fruit** not seen.

*Distribution.* Bangladesh, China, India, Lao P.D.R., Myanmar, Thailand.

*Ecology & phenology.* Found in tropical to subtropical evergreen or semi-deciduous forest, often in alluvial soils near streams or in disturbed forest areas and margins. Flowers from May to September with a two-day flowering cycle for each flower.

*Additional Myanmar specimens examined.* **Mandalay Region:** Maymyo Hills, Jun 1888, Khan 50 (CAL!); Kyaukpadaung Township, Mt. Popa Park, 17 May 1996, Kress, *W.J.* 96-5646 (US!). **Sagaing Region:** Katha Dist., Pile R.F., 20 Aug 1915, Rogers, *C.* 991 (CAL!); Kani Township, Alaungdaw Kathapa National Park, 17 Jul 1997, Kress, *W.J.* 97-5821 (US!); Kani Township, Magu Range, along Ngabwe Stream, 370 m, 13 Apr 2000, Kress, *W.J.* 00-6646 (US!); Kani Township, Alaungdaw Kathapa N.P., 470 m, 15 Apr 2000, Kress, *W.J.* 00-6661 (US!). **Shan State:** 45 miles east of Pyin-Oo-Lwin, 630 m, 26 Jun 2003, Kress, *W.J.* 03-7366 (US!).

*Notes.* This species is a prolific runner with a mass of rhizomes from 5–10 mm diameter. In some areas of NE India it has been observed to spread into large populations from a single plant. This was noted on *C. Rodgers 991* (CAL) collected in the Sagaing Division: “prevents natural regeneration of teak (*Tectona grandis* L.f.)”. This aggressive rhizome system is believed to be the primary reason for its wide distribution from Sikkim, India to the Lao P.D.R. The flower is the largest yet recorded in *Boesenbergia* with a floral tube length to c. 16 cm. The flower colour on the type is white with a bright red throat, but there are numerous variations with known hybrids (Mood et al., 2013).

**4. *Boesenbergia longiflora*** (Wall.) Kuntze, Revis. Gen. Pl. 2: 685 (1891). – *Gastrochilus longiflorus* Wall., Pl. Asiat. Rar. 1: 22, t. 25 (1829) (“*longiflora*”). – *Curcumorpha longiflora* (Wall.) A.S.Rao & D.M.Verma, Bull. Bot. Surv. India 13: 339 (1974). – TYPE: Burma, Rangoon, 1827, Wallich, *N.* 6589A (lectotype K, designated by Mood et al. (2013)). (Fig. 3C–D)

**Deciduous herb** up to 1 m tall. **Rhizome** small, irregularly shaped, c. 1 cm diam., externally brown, internally light yellow to white; multiple, small bulb-like rhizomes above the main rhizome, c. 1 cm long, pink or white; tuberous roots two or more, c.  $8 \times 0.5$  cm, swelling at the terminus, c.  $2 \times 1$  cm, externally white or pink, internally white, root hairs few, c. 20 mm long, thin, white. **Stem** to c. 1 cm, covered by leaf sheaths forming a pseudostem, base 2–2.5 cm diam.; *leafless sheaths* 1–2, 1–2 cm long. **Leaves** 5–8 per pseudostem; leaf sheaths 10–16 cm, longitudinally ridged, green, glabrous, margin hyaline; *ligule* slightly bilobed, lobes an extension of the hyaline margin, 2 mm long, slightly acute, protruding outward, green, glabrous; *petiole* 9–18 cm, deeply channelled, green, glabrous; *lamina* elliptic or broadly ovate,  $41\text{--}61 \times 20\text{--}21$  cm, plicate, adaxially dark green, glabrous, abaxially lighter green, glabrous with a few hairs on the midrib, base rounded to cordate, sometimes asymmetric, apex acute to long acuminate. **Inflorescence** radical, c. 3–4 per pseudostem, up to c. 12 cm long (including peduncle) produced from the side of the rhizome; *peduncle* 1–3 cm long, white, glabrous, basal sheaths 1–2, pink and white, glabrous; *spike* horn-shaped,  $5\text{--}10 \times 1\text{--}2$  cm; *bracts* 3–4, distichous, cymbiform,  $5\text{--}6 \times 1.5$  cm, red and green, glabrous, each bract enclosing one flower, some basal bracts sterile, apex sometimes curved; *bracteole* cylindrical, c.  $5 \times 0.5$  cm, white, translucent, glabrous, open to the base, apex acute. **Flowers** 2–3 per inflorescence, up to c. 11 cm long. Calyx tubular,  $20 \times 5$  mm, white, translucent, glabrous, apex bidentate; *floral tube* 10 cm long, c. 3 mm wide at the base, white, glabrous externally and internally, *dorsal* and *lateral* corolla lobes linear to lanceolate, c.  $2 \times 0.5$  cm, yellowish-white, glabrous, margins involute; *androecial cup* 4–5 mm long, c. 7 mm diam. at the top, yellowish-white, glabrous externally and internally; *labellum* saccate, semi-orbicular, 2.2–2.5 cm long, 2–2.2 cm wide (when flattened at broadest point), light yellow, throat centre dark red, maculate with yellow showing through as dots, red pattern broadening to the lip apex, glabrous, margin wavy, wrinkled, revolute on the sides, apex elongate, emarginate; *lateral staminodes* obovate, c.  $1.3 \times 1$  cm, light yellow, glabrous, apex rounded. **Stamen** c. 8 mm long, filament c. 1 mm long, c. 2 mm wide at base, light yellow, few short glandular hairs, anther c.  $7 \times 2$  mm (first day) then c. 5 mm wide (thecae diverging on the second day) apex rounded, anther crest absent, thecae c.  $7 \times 1$  mm, white, dehiscing along the entire length. **Ovary** cylindrical, c.  $7 \times 3$  mm, white, glabrous; *style* filiform, white, glabrous, stigma rounded, white, ostiole transverse, non-ciliate, exuding a sticky liquid on the second day; epigynous glands 2, linear, c. 4 mm long, light yellow. **Fruit** not seen.

**Distribution.** Known only from Myanmar.

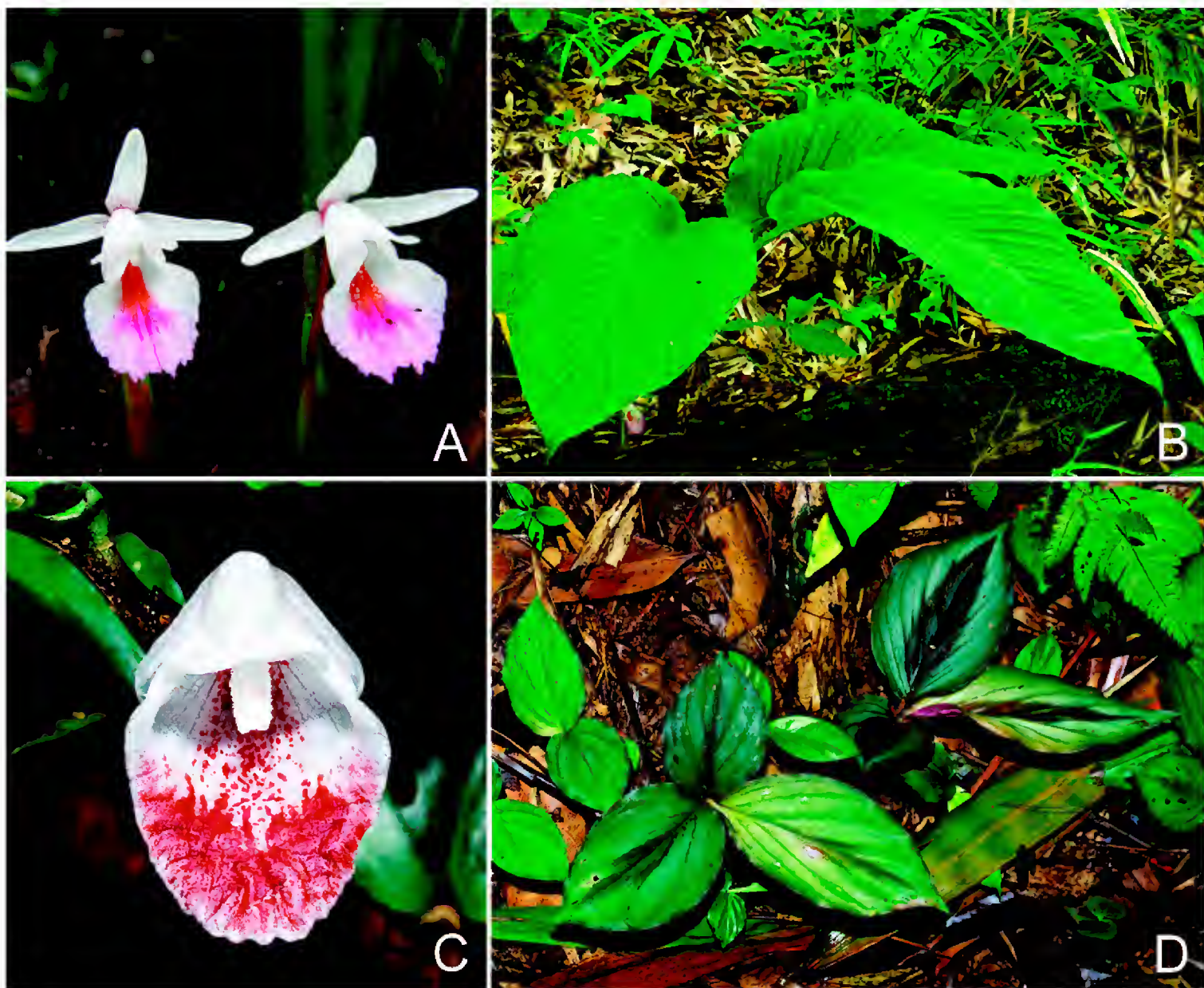
**Ecology & phenology.** Found in the understorey of primary teak forest. Flowering from May to September with a two-day flowering cycle for each flower.

**Additional Myanmar specimens examined.** **Rakhine State:** 12 miles N of Thandwe toward Taung-Gok, Kress, W.J. 03-7305 (US!); 32 miles N of Sittwe, along road to Mrauk U, N. of Ponnagyun, Kress, W.J. 04-7772 (US!). **Yangon Region:** Insein District, Myaukhlaing Reserve, evergreen forest, sandy places, 30 m, 11 Jun 1948, Khant, P. 426 (RAF!).

*Notes.* This species is similar to *Boesenbergia kerrii*, *B. kingii* and *B. maxwellii* as all three have radical inflorescences produced from the rhizome, but is easily distinguished from the latter two by the yellow flowers. Not much is currently known about the species even though it was first collected in 1826. More collections are needed to verify its variation and preferred habitat.

**5. *Boesenbergia maxwellii*** Mood & L.M.Prince, Gard. Bull. Singapore 65: 72, t. 12, 13, 18, 19D (2013). – TYPE: Thailand, Tak Province, 1 November 2012, *Mood, J. & Triboun, P. 12P172* (holotype BK!). (Fig. 4A–B)

***Deciduous herb*** c. 1–1.5 m tall; ***rhizome*** irregular in shape, 1–2 cm diam., externally yellow, internally light violet; ***roots*** fleshy, cylindrical, 10–20 cm long, 0.5–0.8 cm diam., very numerous, extending downward from the rhizome base, externally white, internally translucent white, core pinkish, the terminus swollen into a sphere, c. 2 × 3 cm, root hairs c. 18 mm long, c. 2 mm diam., white. ***Stem*** to c. 10 cm, c. 1 cm diam., white, glabrous, covered by 4–6 leaf sheaths forming a pseudostem, to c. 30 cm long; ***leafless sheaths*** 1–2, reddish, becoming dry, papery. ***Leaves*** 4–6; ***leaf sheaths*** to c. 48 × 2.5 cm, green, glabrous, ribbed; ***ligule*** bilobed, lobes c. 2 mm, acute; ***petiole*** 5–30 cm, light green, glabrous, finely ribbed; ***lamina*** elliptic, 33–50 × 15–25 cm, base rounded to cordate, apex acute, adaxially dark green, glabrous, abaxially lighter green, slightly pubescent or glabrous. ***Inflorescence*** radical, 3–10 per stem, attached to the rhizome from below the stem, 4–6 flowers each; ***peduncle*** 3–5 cm long, 0.5–8 cm diam., white or pink, glabrous, 1–2 basal sheaths, 3.5–4.5 × 1–1.5 cm; ***spike*** horn-shaped, 8–10 cm long, c. 2 cm diam.; ***bracts*** 4–6, distichous, cymbiform, white and pink or red; ***bracteole*** cymbiform, c. 4 × 0.5 cm, translucent, glabrous, apex bidentate. ***Flowers*** 12–16 cm long; ***calyx*** tubular, c. 3 cm long, c. 0.5 cm diam., white, translucent, apex tridentate; ***floral tube*** 12–14 cm long, c. 3 mm diam., white with a pink tinge; ***dorsal corolla lobe*** oblong, c. 3.6 × 1.3 cm, white, glabrous, apex cucullate, margins involute, ***lateral corolla lobes*** oblong c. 4.3 × 1 cm, white, glabrous, apex cucullate, margins involute; ***androecial cup*** 10–16 mm long, oriented c. 45° to the floral tube, throat glabrous; ***labellum*** slightly saccate, broadly oval, 4.5–5 × 2.7–3 cm, white, abaxially with few glandular hairs, throat orange-red in centre, maculate with white showing through as dots ending at the lip, dark pink band with lighter pink to the apex, surface and margins crisped, apex entire, irregular, revolute; ***lateral staminodes*** obovate, c. 2.3 × 1 cm, pure white, margins irregular, apex revolute, abaxially with few glandular hairs. ***Stamen*** c. 12 mm long; ***filament*** c. 3 × 2 mm, white, few glandular hairs; ***anther*** c. 10 × 3 mm (first day), c. 10 × 6 mm (second day), white, glabrous, ***thecae*** c. 10 × 1 mm each, white, dehiscent along the edge for full length, anther crest absent. ***Ovary*** cylindrical, c. 7 × 3 mm, white, glabrous; ***stigma*** semi-spherical, ostiole oval, non-ciliate, exuding a sticky liquid on the second day; ***epigynous glands*** 2, linear, c. 6 mm long, tan. ***Fruit*** cylindrical, c. 15 × 6 mm, glabrous, white, three longitudinal ridges, calyx and floral tube remain partially intact; ***seed*** globular, c. 3 mm diam., hirsutulous, yellowish-brown, aril white, translucent.



**Fig. 4.** **A, B.** *Boesenbergia maxwellii* Mood & L.M. Prince. **C, D.** *Boesenbergia parvula* (Wall. ex Baker) Kuntze. A & B from Funakoshi, H. *et al.* 085387; C & D from Mood, J. & Chalermglin, P. 3460. (Photos: A & B, H. Funakoshi (BRIC, Japan); C & D, J. Mood)

*Distribution.* Lao P.D.R., Myanmar, Thailand.

*Ecology & phenology.* Found in mountainous areas in tropical evergreen or semi-deciduous forest. Flowering from May to September with a two-day flowering cycle for each flower.

*Additional Myanmar specimens examined.* **Chin State:** Along the roadside, Natma Taung (Mt. Victoria) National Park, Tanaka, N. *et al.* 023015 (MBK, TI!); between Kampetlet and Saw, 21°11.03'N 94°06.8'E, 760 m asl, Funakoshi, H. *et al.* 085387 (MBK, RAF!); Natmataung N.P. above Kampetlet, near guest house, 1635 m, 10 Nov 2004, Kress, W.J. 04-7722 (US!); Natmataung N.P. above Kampetlet, 1635 m, 10 Nov 2004, Kress, W.J. 04-7724 (US!). **Mandalay Region:** Near the Education Center, Mt. Popa, 17 Jun 2000, Khin Myo Htwe 020380 (MBK, TI, herbarium of Education Centre, Popa Mountain Park!). **Sagaing Region:** Kani Township, Butolong Reserve, 500 m, 16 Jul 1997, Kress, W.J. 97-5817 (US!); Kani Township, Magu Range, along Ngabwe Stream, 370 m, 13 Apr 2000, Kress, W.J. 00-6639 (US!); Kani Township, Magu Range, along Ngabwe Stream, 375 m, 13 Apr 2000, Kress, W.J. 00-6647 (US!).

*Notes.* The flower of this species is large and showy with an orange throat and dark pink crinkled lip margin, but many variations in labellum colour pattern and tint have been observed. It is sometimes difficult to distinguish from *Boesenbergia kingii* from flowers alone as hybrids between the two are known (Mood et al., 2013). Vegetatively, *Boesenbergia maxwellii* is distinguishable by its clumping, few-stemmed habit and long, vertical, tuberous roots. Also, it tends to grow at higher elevations than *Boesenbergia kingii*.

**6. *Boesenbergia parvula*** (Wall. ex Baker) Kuntze, Revis. Gen. Pl. 2: 685 (1891). – *Gastrochilus parvulus* Wall. ex Baker in Hook.f., Fl. Brit. India 6: 218 (“*parvula*”) (1890). – TYPE: Burma, Tavoy, 1827, Gomez, W. in Wallich, N. 6590 (lectotype K-W!, designated here). (Fig. 4C–D)

***Deciduous herb*** to c. 30 cm, upright to prostrate. ***Bud-crowned tuberous root***, cylindrical, 1–13 cm long, to c. 2 cm diam., often several attached together at the proximal end, internally and externally white, covered in short roots; *roots* few, fleshy, to c. 3 mm, fibrous roots few, short. ***Stems*** succulent, internodes short, branched from the lower leaf axils; *leafless sheaths* corrugate, red or green. ***Leaves*** alternating along the stem, 5–7, mostly congested near the terminus; *leaf sheaths* 1–3, c. 2 cm long, corrugate, red or green; *ligule* bilobed, to c. 5 mm, lobes triangular, green; *petiole* subsessile to c. 2 cm, ribbed; *lamina* oval, to 10 × 5 cm, base attenuate, apex acuminate, adaxially green, with or without a darker centre and silver margins, glabrous, abaxially green or reddish, mostly glabrous. ***Inflorescence*** terminal on the main stem and axillary stems, tightly clasped between the leaf sheaths, partially exerted, mucilaginous, 3–7 flowers; *peduncle* to 1 cm long, white; *spike* fusiform, to c. 4 cm long; *bracts* 3–5, distichous, lanceolate, to c. 3 cm long, apex acuminate, green or red, covered portions white, glabrous, finely striate; *bracteole* lanceolate, to 2.5 cm long, green or white, glabrous. ***Flowers*** c. 3 cm long, oriented 90° to the bract, deflexed downward; *calyx* c. 3 mm long, white, translucent, apex irregular; *floral tube* 1.5–3.5 cm long, white, glabrous; *dorsal and lateral corolla lobes* ovate, c. 10 × 5 mm, apex cucullate, white, glabrous; *androecial cup* c. 5 mm long, oriented c. 90° to the floral tube, throat with hairs; *labellum* deeply saccate, nearly orbicular, c. 2.5 × 2 cm, white with various red patterns, glabrous, apex entire, margins deflexed; *lateral staminodes* obovate, c. 7 × 5 mm, white, glabrous. ***Stamen*** c. 9 mm long, white, glandular hairs for full length; *filament* c. 2 mm long; *anther* c. 6 × 3 mm, white, *thecae* 5 × 1.5 mm, dehiscent for full length, anther crest absent. ***Ovary*** cylindrical, c. 3 × 2 mm, white, glabrous; *style* filiform, c. 4 cm long, white; *stigma* orbicular, white, ostiole circular, ciliate; *epigynous glands* 2, linear, c. 2 mm long, light green. ***Fruit*** cylindrical, c. 1.2 cm long, tan; *seed* elongate c. 6 × 2 mm, brown, hirsutulous, aril medusa-form, c. 3 mm long, white, translucent, funiculus c. 2 mm diam., white. ***Bulbils*** cylindrical, 1–1.5 × 0.7 cm, green, sericeous, occurring under the leaf sheaths at stem nodes.

***Distribution.*** Lao P.D.R., Thailand, Vietnam.

*Ecology & phenology.* Found in tropical evergreen or semi-deciduous forest near streams in well shaded areas, often in association with bamboo. This species forms large, spreading populations on hillsides and stream banks where there is good drainage. Flowering occurs from June to September.

*Additional Myanmar specimens examined.* **Shan State:** Gokteik Gorge, 450 m, 2 Aug 1908, *Lace, J.H. 4163* (E!). **Tanintharyi Region:** Half mile east of Paungdaw Power station, Aug 1961, *Keenan, J. et al 738* (E!); Inland of river east of Paungdaw Power Station, Aug 1961, *Keenan, J. et al. 829* (E!); Hills west of Paungdaw Power Station, *Keenan, J. et al. 971* (E!); 2.5 miles east of Paungdaw Power Station, Aug 1961, *Keenan, J. et al. 1008* (E!); East of Paungdaw Power Station, Sep 1961, *Keenan, J. et al. 1399* (E!); Mainmapan, Taninthayi Reserved Forest, Yephyu Township, 14°37'22.63"N 98°08'17.24"E, 17 m asl., 15 Aug 2015, *Tanaka, N. et al. 138* (RAF, TNS!); East of Myitta, 176 m asl, 11 Jul 2014, *Mood, J. & Chalermglin, P. 3460* (BKF!).

*Notes.* This species is easily distinguished from others currently recorded in Myanmar by its small stature and branched-stem habit. The axillary stems are mostly prostrate and can also flower. The main stem usually has 3–6 leaves toward the stem terminus where a small, few-flowered inflorescence occurs. Often the adaxial lamina surface is variegated with a dark green feathered midrib with silvery green on either side extending almost to the margin. Abaxially the lamina is green or bright wine-red. Plants are almost always found in large populations as they are known to produce bulbils in the leaf axils late in the season prior to dormancy. These help to proliferate the species clonally.

**7. *Boesenbergia pulcherrima*** (Wall.) Kuntze, *Revis. Gen. Pl.* 2: 685 (1891). – *Gastrochilus pulcherrimus* Wall., *Pl. Asiat. Rar.* 1: 22, t. 24 (“*pulcherrima*”) (1829). –TYPE: Illustration in Wallich, *Pl. Asiat. Rar.* 1: 22, t. 24 (1829) [lectotype designated by Aishwarya & Sabu (2015)]. (Fig. 5A–B)

***Deciduous herb*** to c. 70 cm, upright to slightly decumbent, number of stems variable (one or more). ***Rhizome*** with multiple elements developing horizontally, spherical, c. 2 cm diam., externally golden brown, internally white; ***roots*** fleshy, swollen, c. 6 cm long, c. 1 cm diam., externally and internally white, broadest at the terminus, fibrous roots c. 2 mm diam., white. ***Stems*** to 50 cm, c. 1 cm diam., semi-rigid, nodes c. 10 cm apart; ***leafless sheaths*** 1–2, c. 12 cm long, green or reddish, finely ribbed. ***Leaves*** alternate, 6–8, ***leaf sheaths*** to c. 18 cm long, finely ribbed, green; ***ligule*** bilobed, to 1.5 cm, green becoming papery, glabrous, apices rounded; ***petiole*** subsessile, finely ribbed; ***lamina*** elliptic, to c. 25 × 9, base attenuate, apex acuminate, adaxially with raised veins, dark green, abaxially green or reddish-purple, glabrous. ***Inflorescence*** terminal, clasped between the leaf sheaths, partially exerted, c. 15 flowers; ***peduncle*** to 1 cm long, green, glabrous; ***spike*** oblong, to 13 × 1.5 cm, c. 1 cm thick; ***bracts*** c. 14, distichous, lanceolate, c. 5 × 1.5 cm, radially congested in two rows (one-sided), finely ribbed, light green, papery, sericeous; ***bracteole*** elliptic, to c. 3.5 × 1 cm, white,

sericeous. **Flowers** to c. 4 cm long, oriented c. 135° to the floral tube; *calyx* to c. 1 cm, apex mostly entire, white, glabrous; *floral tube* c. 3 cm long, white, glabrous; *dorsal and lateral corolla lobes* elliptic, c. 18 × 8 mm, white, glabrous, apices cucullate; *androecial cup* c. 7 mm long, oriented c. 90° to the floral tube, throat with hairs; *labellum* deeply saccate, obovate, c. 3 × 2 cm, white, throat with two red spots at the base and two parallel red lines broadening outward, the apex longitudinally streaked with red or pink, glabrous, margins entire, apex entire or emarginate, deflexed; *lateral staminodes* obovate to nearly orbicular, c. 1.3 × 1.1 cm, white with two red spots at the base, glabrous. **Stamen** 8–10 mm long, white, glandular hairs for full length; *filament* c. 2 mm long; *anther* 6–7 × 4 mm, broader at the apex than at the base, truncate, *thecae* 6 × 1 mm, dehiscent for full length, divergent at the apices. **Ovary** cylindrical, c. 2 × 2 mm, light green, glabrous; *style* filiform, c. 4 cm long; *stigma* semi-spherical, white, ostiole circular, ciliate; *epigynous glands* 2, linear, c. 1.5 mm, yellow. **Fruit** cylindrical, c. 14 mm long; *seed* c. 5 mm long, pubescent, aril white.

**Distribution.** Lao P.D.R., Myanmar, India, Thailand.

**Ecology & phenology.** Found in mountainous areas in tropical evergreen or semi-deciduous forest, often along streams and in association with bamboo. Flowering from August to November.

**Additional Myanmar specimens examined.** **Bago Region:** Taungoo Dist., 4 Aug 1911, *Lace, J.H. s.n.* (E! [E00389694]); Taungoo Dist., 4 Aug 1911, *Lace, J.H. s.n.* (E! [00389695] in parte, inflorescence = cf. *Cautleya spicata* (Sm.) Baker); Paungpyin Township, 400 m, 13 Jul 2002, *Kress, W.J. 02-7151* (US!); Paungpyin Township, 400 m, 13 Jul 2002, *Kress, W.J. 02-7153* (US!). **Chin State:** Chin Hills, Jun 1892, *Huk, A. s.n.* (SING! [0155288]). **Kachin State:** Metkina, Kachin Hills, Aug 1899, *Shaik Mokim 140* (CAL, P!). **Tanintharyi Region:** Michaung Hlaung (Old village), Tanintharyi Reserved Forest, Yephyu Township, 17 m alt., 15 Aug 2015, *N. Tanaka et al. 154* (RAF, TNS!); Thetkaekawt Compartment, Yephyu Township, 14°20'45.94"N 98°11'28.96"E, 76 m asl, *N. Tanaka et al. 171* (RAF, TNS!).

**Notes.** Three years after Wallich published the protologue, he listed *Wallich 6588* (K-W) in his *Numerical List* (Wallich, 1832) as *Gastrochilus pulcherrima* (*Boesenbergia pulcherrima*). The specimen is of a mature, flowering plant with a c. 10 cm long stem including the inflorescence. This size is in stark contrast to the description and accompanying icon (tab. 24). Recently, Aishwarya & Sabu (2015) lectotypified Plate 24 in Wallich (1829). Prior to this designation, reference to this specimen led to many misidentifications in the herbarium, especially in India and Thailand. It is the first author's opinion that *Wallich 6588* most likely represents *Boesenbergia parvula* as there are no other described species which are similar that are currently found in Myanmar.

In the field, *Boesenbergia pulcherrima* is easily identified by its c. 50 cm long stem with leaves on the upper half, short or sessile petioles, and long, bilobed ligules.





**Fig. 5. A, B.** *Boesenbergia pulcherrima* (Wall.) Kuntze. **C, D.** *Boesenbergia rotunda* (L.) Mansf. A & B from Mood, J. & Vatcharakorn, P. 3363; C & D from Mood, J. & Vatcharakorn, P. 3037. (Photos: J. Mood)

Often the abaxial lamina surface is red or purplish. The inflorescence is partially hidden by the two upper leaf sheaths, although may sometimes be more exerted as depicted in the lectotype (icon). The red and white flowers are very similar to *Boesenbergia parvula*, but larger.

**8. *Boesenbergia rotunda*** (L.) Mansf., Kulturpfl. 6: 239 (1958); Veldkamp, Philipp. J. Sci. 142: 215, t. 1–7 (2013). – [*Manja-kua* Rheede, Hort. Malab. 11: 19, t. 10, (1692), nom. inval, cited by L., Musa Cliff.: 15 (1736)] - *Curcuma rotunda* L., Sp. Pl. 1, 2 (1753). – *Kaempferia ovata* Roscoe, Trans. Linn. Soc. 8: 351 (1807), nom. nov. propter *K. rotundam* L. (1753). – *Gastrochilus rotundus* (L.) Alston, Handb. Fl. Ceylon 6: 281 (1931). –TYPE: Rheede, Hort. Malab. 11: t. 10, (lectotype, designated by Burtt & Smith (1972)). (Fig. 5C–D)

*Zingiber xanthorhizum* Moon, Cat. Ceylon 1 (1824), nom. nud.

*Kaempferia pandurata* Roxb., *Asiat. Res.* 11: 328, t. 2 (1810). – *Gastrochilus panduratus* (Roxb.) Ridl., *J. Str. Branch Roy. As. Soc.* 32: 110, 114 (1899); Veldk., *Philipp. J. Sci.* 142: 216, t. 5, 6 (2013). – *Boesenbergia pandurata* (Roxb.) Schltr. in Fedde, *Repert.* 12: 316 (1913). – TYPE: Roxburgh, *Asiat. Res.* 11, t. 2 (1810), designated by Veldkamp, *Philipp. J. Sci.* 142: 216 (2014).

*Kaempferia cochinchinensis* Gagnep., *Bull. Soc. Bot. France* 54: 165 (1907). – *Gastrochilus cochinchinensis* (Gagnep.) Valetton, *Bull. Jard. Bot. Buitenzorg II*, 27: 88 (“*cochinchinense*”) (1918). – *Boesenbergia cochinchinensis* (Gagnep.) Loes. in Engler & Prantl, *Nat. Pflanzenfam.*, ed. 2, 15a: 571 (1930). – TYPE: Vietnam [‘Cochichine’], Thu-dau-moth, *Thorel s.n.* (lectotype P [P032700], designated here; isolectotype P [P00686540]).

**Deciduous herb** to 1 m tall, upright, variable number of stems per clump. **Rhizome** with multiple elements developing horizontally and vertically, c. 3 × 2 cm, externally and internally yellow-orange; **roots** cylindrical, fleshy, c. 6 × 1 cm, externally and internally light orange, the lower portion near the terminus thicker, slightly spherical; fibrous roots few. **Stems** semi-rigid, of variable length and diameter, covered by 4–6 leaf sheaths forming a pseudostem, variable in length; **leafless sheaths** 1–2, short, red or green, glabrous. **Leaves** highly variable in size, shape and colouration, adaxial surface texture rubbery; **leaf sheaths** extend to the base of the stem forming a pseudostem; **ligule**, **petiole** and **lamina** variable. **Inflorescence** terminal, 5–10 cm long, clasped between the leaf sheaths, sometimes slightly exerted, c. 10 flowers; **peduncle** to 2 cm long, white; **spike** oblong, to c. 6 cm long; **bracts** c. 10, radially congested in two rows (one-sided), lanceolate, c. 3.5 × 0.5 cm, finely ribbed, light green, glabrous; **bracteole** elliptic, to c. 3 × 0.5 cm, white, glabrous. **Flowers** to c. 6 cm long; **calyx** to c. 1.5 cm, apex dentate, translucent, glabrous; **floral tube** c. 4 cm long, white, glabrous, with two glands at the filament base; **dorsal and lateral corolla lobes** oblong, c. 20 × 5 mm, white, glabrous; **androecial cup** absent; **labellum** shortly spatulate, slightly concave, c. 2 × 1.5 cm, white with various combinations of red, pink or violet, crisped, apex entire or emarginate; **lateral staminodes** spatulate, c. 15 × 5 mm, white with translucent veins, glabrous. **Stamen** to c. 8 mm long, white or pinkish, few glandular hairs; **filament** to 2–3 mm long; **anther** to 4–5 × 1–3 mm, **thecae** dehiscent for full length, diverging in the upper half. **Ovary** cylindrical, c. 3 × 2 mm, white, glabrous; **style** filiform, to c. 5.5 cm long; **stigma** flabellate, white or pink, ostiole oval, ciliate; **epigynous glands** 2, linear, c. 5 mm, white. **Fruit** cylindrical, white, glabrous; **seed** brown.

**Distribution.** Widespread, wild and cultivated.

**Ecology & phenology.** Found in a variety of habitats. Flowering from June to October.

**Myanmar specimens examined. Mandalay Region:** Pyin-Oo-Lwin Township, 650 m, 3 Jul 1999, Kress, *W.J.* 99-6511 (US!); Thabeikyin Township, 550 m, 11 Jun 2001, Kress, *W.J.* 01-

6896 (US!). **Sagaing Region:** Road 15 mi E of Chindwinn River, 345 m, 19 Jun 2001, *Kress, W.J. 01-6935* (US); Kani Township, Alaungdaw Kathapa N.P., 625 m, 15 Jul 1997, *Kress, W.J. 97-5804* (US!); Kani Township, Alaungdaw Kathapa N.P., 560, m, 14 April 2000, *Kress, W.J. 00-6648* (US!). **Shan State:** Nawngkhio Township, 25 miles E of Pwin-Oo- Lwin, 730 m, 2 Jul 1999, *Kress, W.J. 99-6502* (US!). **Tanintharyi Region:** Mainmapan, Taninthayi Reserved Forest, Yephyu Township, 14°37'22.63"N 98°08'17.24"E, 17 m alt., 31 Jul 2015, *Tanaka, N. et al. 133* (RAF, TNS!).

*Notes.* This species occurs as both a wild plant and a cultivated plant due to its medicinal and culinary uses. Its vegetative morphology and labellum form are quite variable throughout its range. Consequently, the description above is a rather general one with many variations to be expected. One floral constant is the anther which is longitudinally curved with a long, deflexed crest. No matter the above ground variation, it seems the subterranean architecture mostly remains the same with long, vertical, orange or yellow “keys” or “fingers” which are adventitious storage roots. This is the only species in Myanmar with a fan-shaped (flabellate) inflorescence and crested anther.

### Conclusions

At this juncture it is recognised that several more *Boesenbergia* species are likely to be discovered in Myanmar. One probable example is *Boesenbergia siphonantha* (King ex Baker) M.Sabu et al. which is found in northwest Thailand very close to the Myanmar border. Recently it was added as a new record for Thailand and Vietnam (Mood et al., 2016). One specimen *A. Huk s.n.*, Upper Burma, July 1892 (CAL), cited therein, might be *Boesenbergia siphonantha*, but that collection is rather poor and cannot be positively determined. Common Peninsular Thai/Malay species such as *Boesenbergia curtisii* (Baker) Schltr. and *B. plicata* are also likely to be found in Myanmar when Taninthayi Region is better explored and collected.

ACKNOWLEDGEMENTS. The authors thank Dr Nyi Nyi Kyaw, Director General, Forest Department, and Dr Taung Naing Oo, Director of Forest Research Institute, Forest Department, Myanmar for their arrangement of our field trips; W.J. Kress and M. Bordelon for assistance (US); and T. Ohi-Toma for his arrangement of the samples. This study was partially supported by JSPS KAKENHI Grant Numbers 13375003 (to J. Murata), 23770101 and 15K07207 (to N. Tanaka).

### References

- Aishwarya, K. & Sabu, M. (2015). *Boesenbergia pulcherrima* and *B. tiliifolia* (Zingiberaceae) in India: Notes on the identity, variability and typification. *Rheedea* 25: 59–68.
- Baker, J.G. (1890). Scitamineae. In: Hooker, J.D. (ed) *The Flora of British India* 6: 198–264. London: L. Reeve & Co.

- Burt, B.L. & Smith, R.M. (1972). Key species in the taxonomic history of Zingiberaceae. *Notes Roy. Bot. Gard. Edinburgh* 31: 177–227.
- Hundley, H.G. (1987). *List of Trees, Shrubs, Herbs and Principal Climbers, etc. recorded from Burma with Vernacular Names*, 4th Revised Ed. Rangoon: Forest Department, Swe Daw Oo Press.
- Hundley, H.G. & U Chit Ko Ko (1961). *List of Trees, Shrubs, Herbs and Principal Climbers, etc. recorded from Burma with Vernacular Names*, 3rd Ed. Rangoon: Superintendent., Govt. Printing and Stationary.
- Kress, W.J., Prince, L.M. & Williams, K.J. (2002). The phylogeny and a new classification of the gingers (Zingiberaceae): Evidence from molecular data. *Amer. J. Bot.* 89: 1682–1696.
- Kress, W.J., DeFilipps, R.A., Farr, E. & Kyi, Y.Y. (2003). A checklist of the trees, shrubs, herbs and climbers of Myanmar. *Contr. U.S. Natl. Herb.* 45: 1–590.
- Kuntze, O. (1891). *Revisio Generum Plantarum* 2: 685. Leipzig: Felix.
- Lace, J.H. (1912). *List of Trees, Shrubs, Herbs and Principal Climbers, etc. recorded from Burma*. Rangoon: Forest Department, CCF.
- Mood, J.D., Prince, L.M., Veldkamp, J.F. & Dey, S. (2013). The history and identity of *Boesenbergia longiflora* (Zingiberaceae) and descriptions of five related new taxa. *Gard. Bull. Singapore* 65: 47–95.
- Mood, J.D., Trần H.Đ., Prince, L.M. & Veldkamp, J.F. (2016). *Boesenbergia siphouantha* (Zingiberaceae) – A new record for Thailand and Vietnam. *Gard. Bull. Singapore* 68: 125–137.
- Rodger, A. (1922). *List of Trees, Shrubs, Herbs and Principal Climbers, etc. recorded from Burma with Vernacular Names*, Ed. 2. Rangoon: Forest Department.
- Thiers, B. (continuously updated). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/> (accessed on 12 Jul. 2016).
- Tong, S.Q. (1986). A new species of *Boesenbergia* from Yunnan. *Acta Phytotax. Sin.* 24: 323.
- Wallich, N. (1829). *Plantae Asiaticae Rariores* 1: 22–23. London: Treuttel & Wurz.
- Wallich, N. (1832). *A Numerical List of Dried Specimens of Plants in the East India Company's Museum, collected under the superintendence of Dr. Wallich, of the Company's Botanic Garden at Calcutta (The Wallich Catalogue)*. London: Wallich.

## ***Memecylon cerasiforme* (Melastomataceae): a poorly known species rediscovered, redescribed and newly recorded for India**

K. Karthigeyan<sup>1</sup>, M. Das Das<sup>1</sup> & L.S. Wijedasa<sup>2,3,4</sup>

<sup>1</sup>Botanical Survey of India, Central National Herbarium,  
Howrah – 711103, India

karthigeyan.murthy@gmail.com

<sup>2</sup>Theoretical Ecology and Modelling Lab,  
Department of Biological Sciences,

National University of Singapore, Singapore 117543

<sup>3</sup>ConservationLinks, 433, Clementi Avenue 3,  
#01-258, Singapore 120433

<sup>4</sup>Rimba, Kuala Berang 21700,  
Terengganu, Malaysia

**ABSTRACT.** The species *Memecylon cerasiforme* Kurz was previously known only from the type which was collected in Chittagong, Bangladesh. A recent collection of the species from the Jaldapara National Park, West Bengal, India is not only the first since the species was described in 1877 but also the first record of its occurrence in India and the first flowering collection. Its flowers can now be described and illustrated for the first time. An emended description, figure, phenological and habitat information, notes on related species, and a conservation assessment are also provided. The only original material available at Kew is designated here as a lectotype.

**Keywords.** Conservation status, lectotypification, West Bengal

### **Introduction**

*Memecylon* L. is a genus of Old World tropical trees consisting of 317–343 described species (Renner et al., 2007; Hughes, 2013). Clarke (1879) enumerated 40 species and 27 varieties of *Memecylon* in the *Flora of British India*, of which 14 species and nine varieties were from within the present political boundaries of India. While a number of these species have since been synonymised, the discovery of new species has increased the number of accepted taxa in India to 49 (Das Das et al., 2015). The southern peninsular region of India has been the focus of recent botanical works and accounts for 34 of the currently known species (Manickam et al., 2007; Sivu et al., 2014a, 2014b).

The forests in Northeast India, which are contiguous with Myanmar and northern Thailand, remain relatively underexplored. Currently, six species are known from Northeast India, viz. *Memecylon celastrinum* Kurz, *M. edule* Roxb., *M. elegans* Kurz, *M. ovatum* Sm., *M. plebejum* Kurz and *M. scutellatum* (Lour.) Hook. & Arn.

Ongoing taxonomic studies have extended the range of some of these species into Thailand and Indochina (Hughes & Wijedasa, 2012).

*Memecylon cerasiforme* Kurz (1877) was described from a specimen from Chittagong in Bangladesh. The description was based on a fruiting specimen. There is a specimen in Kew with the handwriting of Kurz stating ‘This is the largest half of the cut specimen at Calcutta’. The other half of the specimen referred to by Kurz could not be traced at CAL. The Kew specimen matches the description provided in the protologue well and is hence designated here as the lectotype of *Memecylon cerasiforme*.

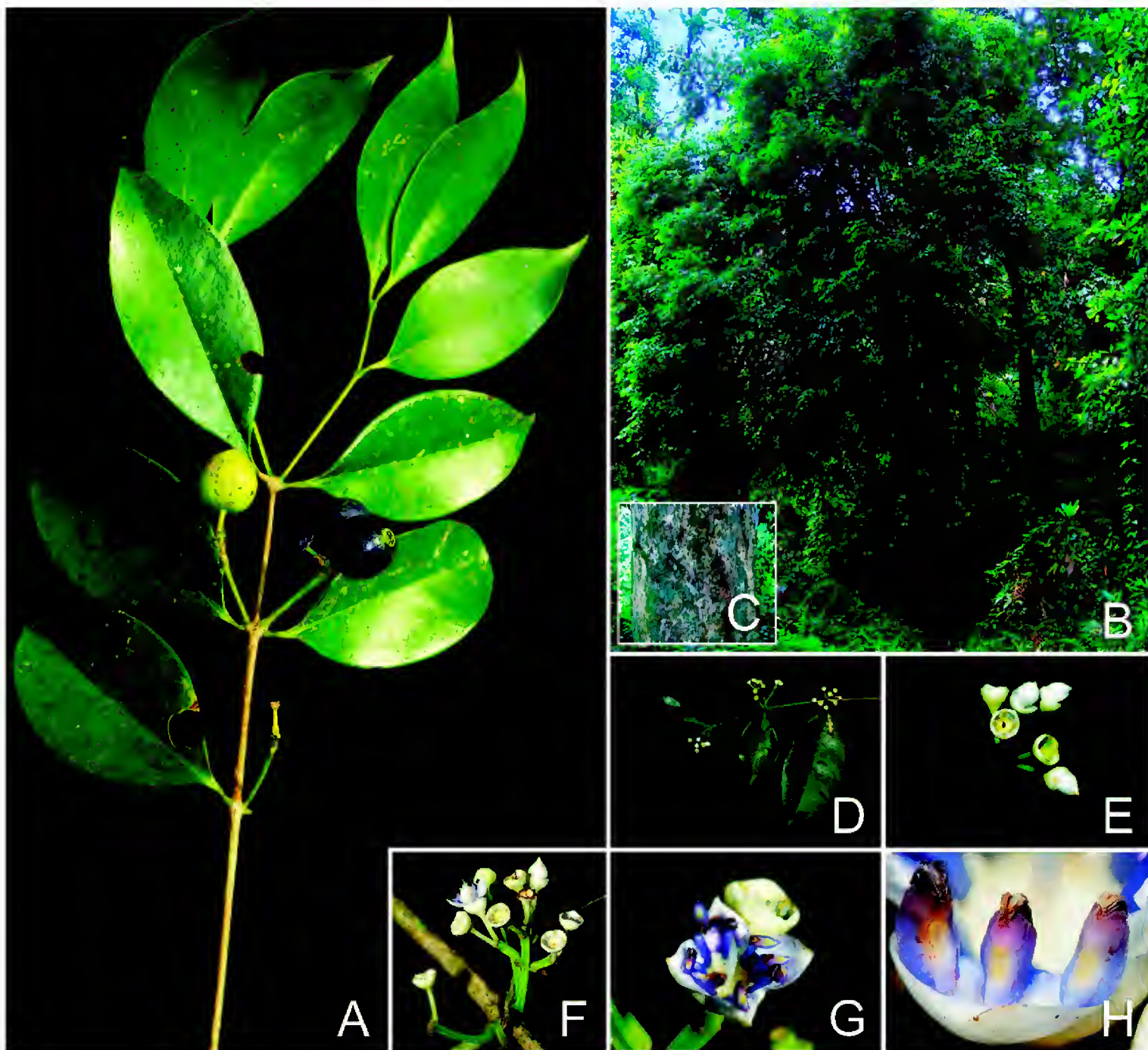
While carrying out a floristic inventory of the Jaldapara National Park in West Bengal state, India, a population of *Memecylon cerasiforme* was found. Specimens were collected in fruit in 2013 and in flower the following year.

We supplement the original type description of this poorly known species with characters from the recent collections, especially flower characters which were absent from the original description. The plant is also illustrated. The description is based on recent repeated visits to observe, document and collect specimens from the population of this species in Jaldapara National Park in eastern India. The conservation status of the species is also assessed here.

### Taxonomic Notes

*Memecylon cerasiforme* Kurz, Forest Fl. Burma 1: 516 (1877). – TYPE: Bangladesh, Chittagong, s.d., Kurz, *S. s.n.* (lectotype K! [K000357772]), designated here). (Fig. 1–3)

**Tree**, 10–15 m high; bole 20–35 cm in diam.; **bark** thin, greyish-brown; young branchlets greenish, slightly flattened on 2 sides, grooved in the middle, becoming brown, terete when mature. **Leaves** opposite, simple, blade elliptic to obovate-elliptic, 6–10 × 3–4.5 cm, thin-coriaceous, cuneate to attenuate at base, margins entire, long-acuminate to caudate-acuminate at apex, acumen 6–10 mm long, dark green, glossy above, pale green beneath, pale green on drying, glabrous, midrib sunken above, raised beneath, lateral veins pinnate, 7–9 pairs, obscure above, faintly visible beneath, regularly spaced, marginal vein faintly visible in dry specimens, 1.5–2.5 mm from margin. **Petioles** 5–10 × 1.5–2 mm, glabrous, canaliculate. **Inflorescences** axillary and terminal, lax, compound cymes, 4–30-flowered; primary peduncles 1–4 at a node, well-developed, 4-angled, 5–13 mm long, elongating in fruits up to 20 mm., 1.5–2 mm thick, grooved, green, glabrous, secondary peduncles 8–10 mm long, glabrous; bracts triangular, c. 1 × 0.8 mm, pale brownish; pedicels 5–8 mm, subterete, pale green, glabrous. **Flowers** bisexual, buds subglobose, pointed at apex, pale purplish white; calyx funnel-shaped, calyx rim very shallowly 4-lobed, glabrous, 3.5–5 mm across, lobes c. 1 × 2.5 mm; internally strongly ridged; petals sub-orbicular, 3.8–4 × 3.2–3.5 mm, acute at apex, entire along margins, shortly clawed, claw c. 0.5 × 1 mm, pale purplish-white on inner surface, white on outer surface, fleshy in the middle,



**Fig. 1.** *Memecylon cerasiforme* Kurz. **A.** Fruiting-twig. **B.** Habit. **C.** Bark. **D.** Flowering-twig. **E.** Close-up of buds. **F.** Inflorescence. **G.** Close-up of flower. **H.** Close-up of anther. (Photos: K. Karthigeyan)

gradually thinning and membranous along margins, glabrous. **Stamens** 8, equal; filaments subulate, c.  $3.5 \times 0.7$  mm, glabrous, light blue; anthers 8, curved, c.  $2 \times 1$  mm, with a c-shaped connective, connective purple near anther theca changing to light blue towards lower end, gland yellow, c. 0.7 mm long, anther theca purple. **Ovary** unilocular; ovules 10–12, placentation free-central; style subulate,  $5\text{--}6 \times 0.4\text{--}0.5$  mm, pale bluish white, glabrous; stigma white. **Berries** broadly ovoid to subglobose,  $1.2\text{--}1.5 \times 1.2\text{--}1.4$  cm, glabrous, pale green, turning dark blackish purple on ripening, shiny, calyx rim persistent, sunken.

**Phenology.** Flowering May–June; fruiting February–March.

*Habitat and Ecology.* Moist areas of dense semi-evergreen forests in Chilapatha range in the Nalraja Garh area at 60–65 m elevation. The vegetation of this area is classified as sub-Himalayan secondary mixed forests (Champion & Seth, 1968). This region is at the northern fringe of the state in the foothills of sub-Himalayan mountain belts with a moist tropical climate, an annual rainfall averaging 2942 mm and mean monthly relative humidity between 69 and 91%. (Shukla et al., 2014). The other plant species commonly found in this habitat are *Dillenia indica* L. and *Knema erratica* (Hook.f. & Thomson) J.Sinclair.

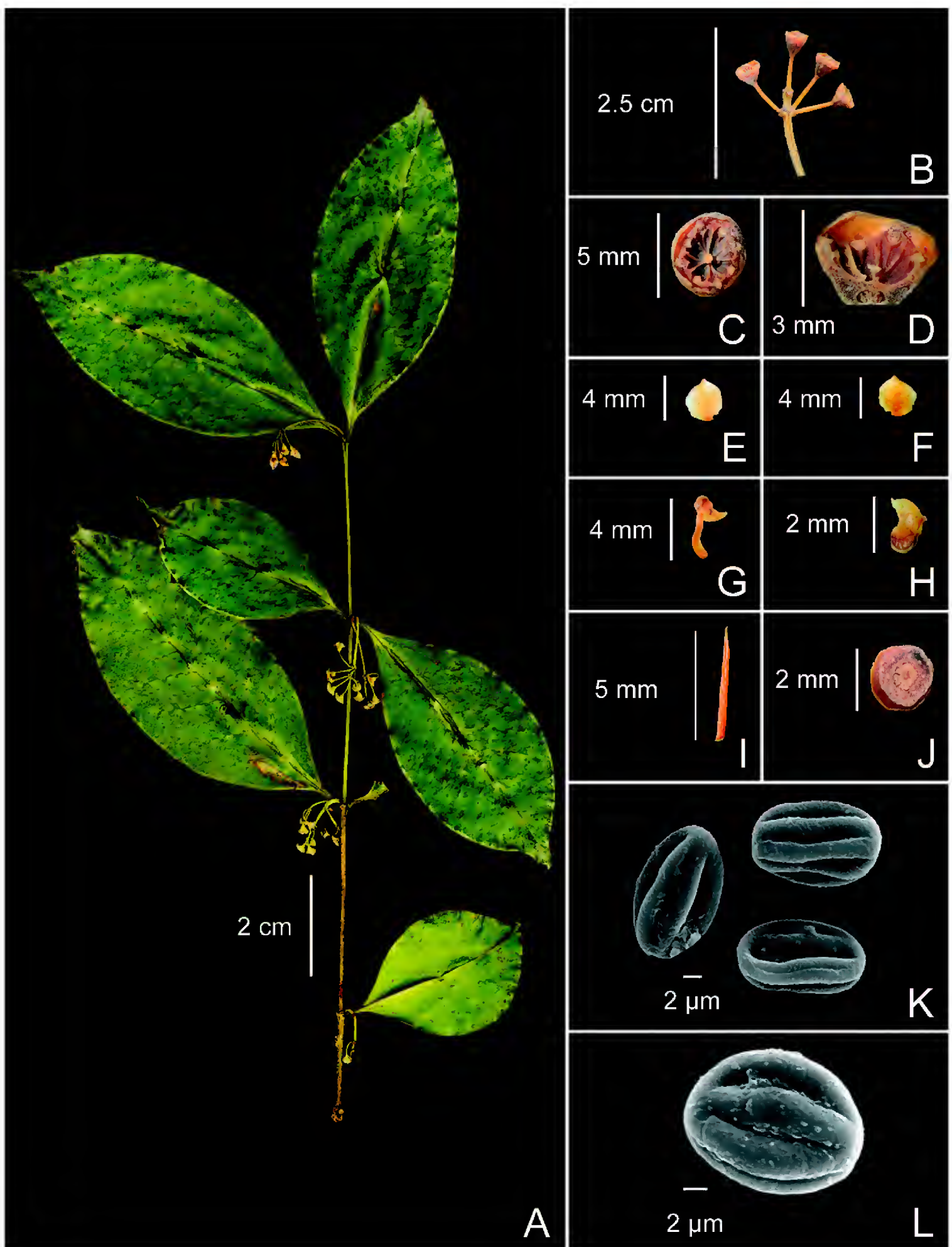
*Provisional IUCN conservation assessment.* Critically Endangered (CR B2a,b(ii, iii, iv, v); D), following the IUCN Red List Categories and Criteria Version 3.1 (IUCN, 2012). During the present study, the only known living population of this species in India was documented in Jaldapara National Park with 15 mature individuals and 35 saplings. This population covers an area less than 1 km<sup>2</sup>. Further it is confirmed that there are no recent collection of the species from the type locality (Chittagong hill tracts, Bangladesh) and no specimens are available in DACB (Sarder Nasir Uddin, Principal Scientific Officer, DACB, pers. comm.). The CR status is due to its continuing decline in AOO, quality of habitat, number of locations or subpopulations and the small number of mature individuals in the population.

*Specimens examined.* BANGLADESH: **Chittagong:** Kurz, S. 557 (K! [K000357772]). INDIA: **West Bengal:** Jaldapara National Park, Chilapatha forest range, Nalraja Garh, 2 Mar 2013, Karthigeyan, K. 59218 (CAL); ibidem, 11 May 2014, Karthigeyan, K. 65007 (CAL); ibidem, 12 May 2014, Karthigeyan, K. 65027 (CAL).

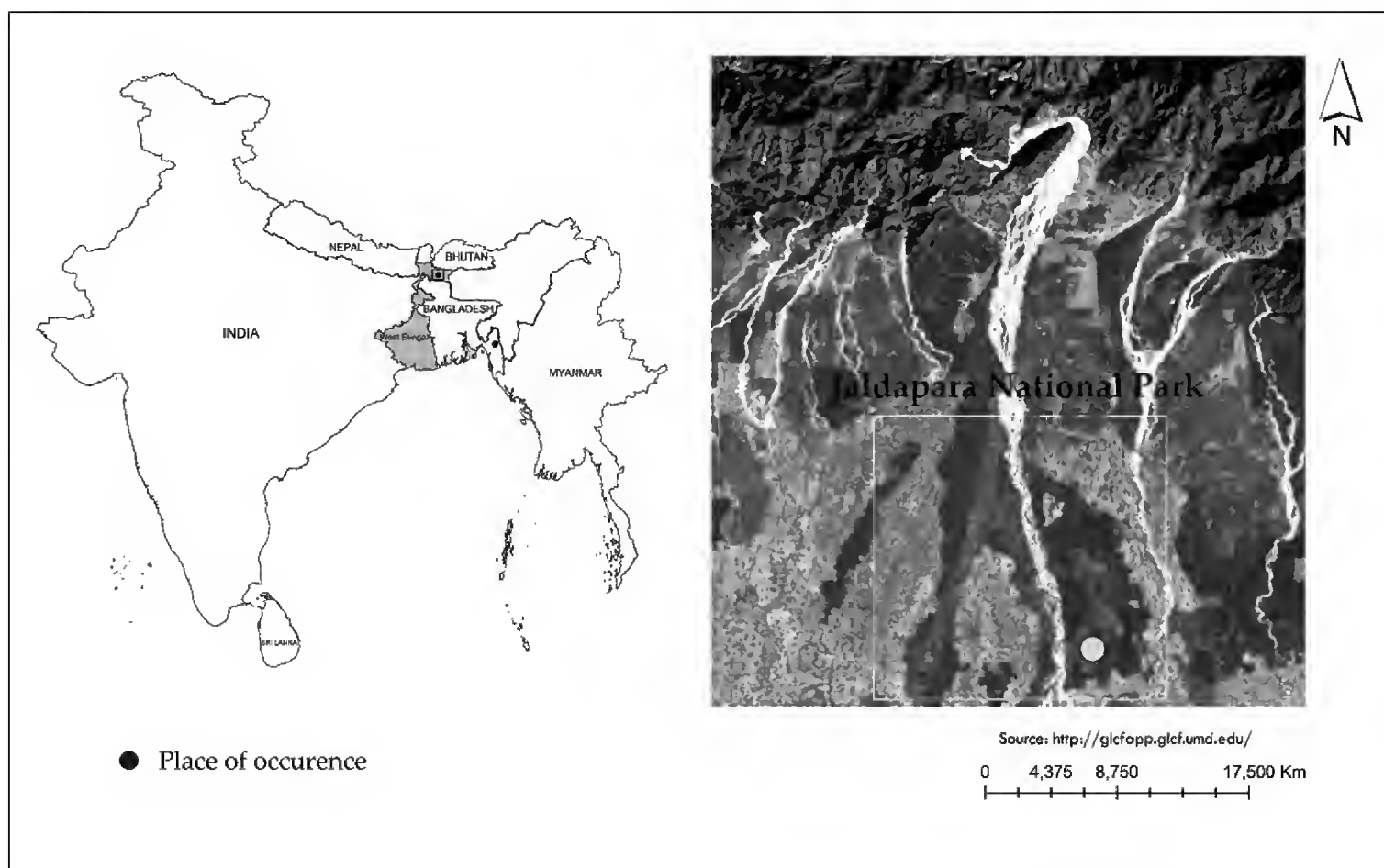
*Notes.* Cogniaux (1891) stated that the peduncle of *Memecylon cerasiforme* is 8 mm long which corresponds to the only type sheet available at Kew [K000357772]. Kurz (1877) stated that the fruiting peduncle is not above ½ in. (= 1.27 cm) long. In most of the specimens from Jaldapara, the peduncle length varies between 5 and 13 mm. The second author, whilst conducting revisionary studies on the genus in India, examined several specimens and found the peduncle length often varying from 0.5 to 1.5 cm within a single species. It is evident from the account of the genus in Sri Lanka (Bremer, 1979) that in some cases peduncle length varies even from 0 to 10 mm within a single plant in some species. The pedicel length in the freshly collected specimens slightly exceeds the documented length (3 mm by Cogniaux and 1 line/2.1 mm by Kurz). It can be assumed that Kurz would have described the species based on a limited number of fruiting specimens which might have had shorter pedicels. In all other characters the new collections fit well within the circumscription of *Memecylon cerasiforme* such as leaf-shape, fruit-size and texture.

In addition to Indian materials the authors have also carefully examined the collections of *Memecylon* from Myanmar and Bangladesh housed at CAL. The only species which *Memecylon cerasiforme* is similar to is *Memecylon celastrinum* Kurz. In the latter, the flower buds are much shorter in size and the petals are very much included in the hypantho-calyx tube with only the apices projecting as a beak in bud.





**Fig. 2.** *Memecylon cerasiforme* Kurz. **A.** Flowering-twig (dried material). **B.** Inflorescence. **C & D.** Calyx. **E & F.** Petals. **G & H.** Anthers. **I.** Style. **J.** Ovary (C.S.). **K & L.** SEM images of pollen grains. (Photos: K. Karthigeyan)



**Fig. 3.** Distribution of *Memecylon cerasiforme* in India (Jaldapara National Park, West Bengal) and Bangladesh.

In the recent collection of *Memecylon cerasiforme*, the buds are larger and the petals are visible throughout their length, except for the basal portion, and they gradually taper to an acute tip. All other taxa occurring in the North-Eastern part of the country and adjacent regions are quite distinct from *Memecylon cerasiforme* and the newly collected material.

*Memecylon celastrinum* is vegetatively similar to *M. cerasiforme* although Kurz (1877) states that *Memecylon celastrinum* has larger leaves than *M. cerasiforme*. We found these two species could not be distinguished based on a comparison of leaves in herbarium and fresh specimens. These species differ considerably, however, in the size of their flowers and fruits. *Memecylon cerasiforme* is known to produce larger fruits (up to 2 cm in diameter) compared to *M. celastrinum* (8–10 mm in diameter). Furthermore, the recent collections of *Memecylon cerasiforme* from Jaldapara National Park, West Bengal showed that the flowers are apparently larger in size with longer petals (3.8–4 mm) compared to *M. celastrinum* which has shorter petals (2–2.25 mm). The present collection of this poorly known species is the first confirmed report of its occurrence from West Bengal. The reports of *Memecylon cerasiforme* by Kanjilal et al. (1938) and Chauhan (2000) were based on misidentifications of the closely allied species, *M. celastrinum*. Thus, the present collection from Jaldapara National Park is the first authentic record of *Memecylon cerasiforme* in India.

ACKNOWLEDGEMENTS. The first and second authors are thankful to Dr Paramjit Singh, Director, BSI, Dr P.V. Prasanna, Scientist 'F' & HoO, Central National Herbarium, Howrah (CAL), Dr A. Pramanik, Scientist 'E' & HoO, A.J.C.B. Indian Botanic Garden, Howrah for facilities and encouragement, and the Principal Chief Conservator of Forest, West Bengal and District Forest Officer, Wildlife Division III, Cooch Behar and Assistant Wildlife Warden, Jaldapara National Park, for their kind permission and support during the survey. Lahiru S. Wijedasa was funded by the Lady Yuen Peng McNiece Graduate Fellowship. We thank Dr Sarder Nasir Uddin, the Principal Scientific Officer at Bangladesh National Herbarium, for information on the specimens at the Bangladesh National Herbarium. The help rendered by Mr G. Gnanasekaran, MH, Coimbatore, for SEM photograph of pollen, Dr C.R. Magesh, CAL, for preparing maps, Mr K. Dinesh Kumar and Mr A. Balaji, for preparing the photo plate, is thankfully acknowledged.

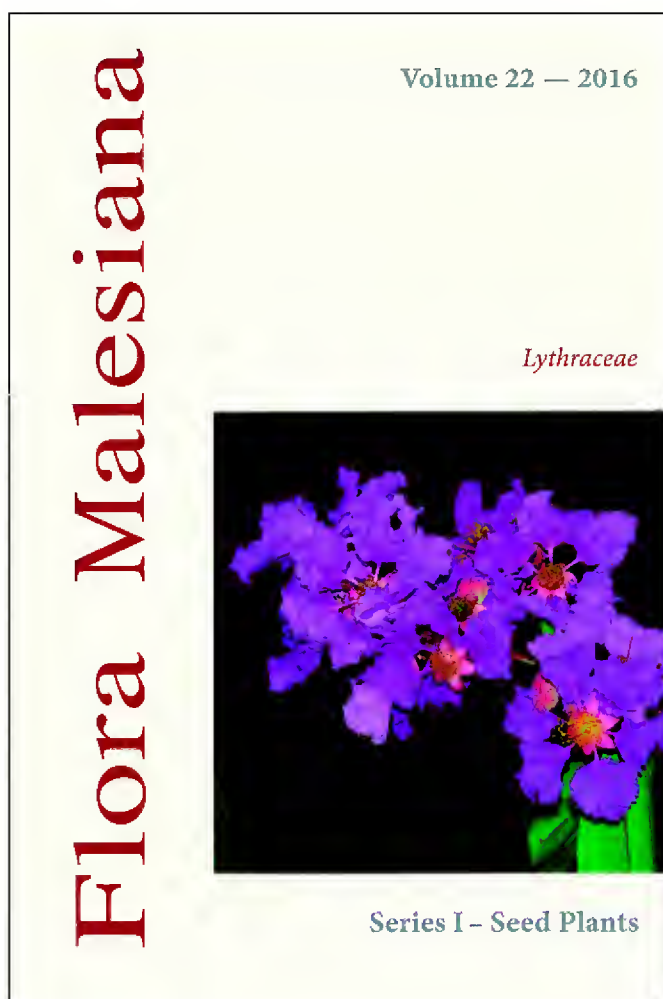
### References

- Bremer, K. (1979). Taxonomy of *Memecylon* (Melastomataceae) in Ceylon. *Opera Bot.* 50: 1–32.
- Champion, H.G. & Seth, S.K. (1968). *A Revised Survey of the Forest Types of India*. 404 p. New Delhi: Manager of Publications, Government of India.
- Chauhan, A.S. (2000). Melastomataceae. In: Singh, N.P., Chauhan, A.S. & Mondal, M.S. (eds) *Flora of Manipur* 1. Pp. 389–398. Calcutta: Botanical Survey of India.
- Clarke, C.B. (1879). Melastomataceae. In: Hooker, J.D. (ed) *The Flora of British India* 2. Pp. 512–565. London: L. Reeve & Co.
- Cogniaux, A. (1891). Melastomataceae. In: De Candolle, A. & De Candolle, C. (eds) *Monographiae Phanerogamarum* 7. Paris: G. Masson.
- Das Das, M., Pramanik, A. & Maity, D. (2015). Typification of the name *Memecylon talbotianum* Brandis (Melastomataceae). *Phytotaxa* 203: 210–212.
- Hughes, M. (2013). Memecylaceae. In: Kiew, R., Chung, R.C.K., Saw, L.G. & Soepadmo, E. (eds) *Flora of Peninsular Malaysia, Series II: Seed Plants* 4. Kepong: Forestry Research Institute Malaysia.
- Hughes, M. & Wijedasa, L.S. (2012). Memecylaceae of Thailand and Peninsular Malaysia. <http://elmer.rbge.org.uk> (accessed on 9 Sep. 2014).
- IUCN (2012). *IUCN Red List Categories and Criteria. Version 3.1* (2nd edition). Gland, Switzerland and Cambridge, UK: IUCN.
- Kanjilal, U.N., Kanjilal, P.C. & Das, A. (1938). *Flora of Assam* 2. Pp. 305–306. Shillong: Assam Government Press.
- Kurz, S. (1877). *Forest Flora of British Burma* 1. 549 p. Calcutta: Office of the Superintendent of Government Printing.
- Manickam, V.S., Murugan, C., Jothi, G.J. & Sundaresan, V. (2007). *Memecylon courtallense* – A new species of Melastomataceae from Courtallum hills of Tamil Nadu, India. *Indian J. Forest.* 30: 77–80.
- Renner, S.S., Triebel, D., Almeda, F., Stone, D., Ulloa, C., Michelangeli, F.A., Goldenberg, R. & Mendoza, H. (2007). MEL names: a Database with Names of Melastomataceae. <http://www.melastomataceae.net/MELnames/> (accessed on 22 Dec. 2015).
- Shukla, G., Biswas, R., Das, A.P. & Chakravarty, S. (2014). Plant diversity at Chilapatha Reserve Forest of Terai Duars in sub-humid tropical foothills of Indian Eastern Himalayas. *J. Forest. Res.* 25: 591–596.

- Sivu, A.R., Ratheesh Narayanan, M.K., Pradeep, N.S. & Shaju, T. (2014a). *Memecylon sahyadrica* (Melastomataceae), a new species from the Western Ghats, India. *Int. J. Advanced Res.* 2: 759–763.
- Sivu, A.R., Ratheesh Narayanan, M.K., Pradeep, N.S., Santhosh Kumar, E.S. & Pandurangan, A.G. (2014b). A new species of *Memecylon* (Melastomataceae) from the Western Ghats, India. *Phytotaxa* 162: 44–50.

**BOOK REVIEW: Flora Malesiana, series I – Seed Plants. Volume 22: Lythraceae. W.J.J.O. de Wilde & B.E.E. Duyfjes. P.C. van Welzen (Ed.) 2016.**

Leiden: Flora Malesiana Foundation. 24 × 16 cm, soft cover, 68 pp, 2 plates with colour photos, 21 black and white line drawings. ISBN 978-90-6519-016-1 (softcover), Price £34.99 (softcover).



Willem J.J.O. de Wilde and Brigitta E.E. Duyfjes between them have completed accounts of Campanulaceae, Coriariaceae, Cucurbitaceae, Hernandiaceae, Myristicaceae, Passifloraceae, Polygalaceae and Stemonaceae for *Flora Malesiana*, altogether comprising many hundreds of species. They have now added the Lythraceae to this list. They are stalwarts of *Flora Malesiana* and, indeed, several other Asian Floras such as the *Flora of Thailand*, *Flora of Peninsular Malaysia* and the *Tree Flora of Sabah and Sarawak*. As was noted in Baas et al. (2016), they accomplish their great feats of taxonomic botany with generosity and good humour.

The account of Malesian Lythraceae comprises 11 genera and 47 species, including alien but naturalised species from genera such as *Cuphea*. The account includes

the genera *Duabanga*, *Punica*, *Sonneratia* and *Trappia*, all now included in Lythraceae, by reference to earlier *Flora Malesiana* accounts when they were placed in different families. As in earlier volumes of *Flora Malesiana*, the introductory parts include a description of the family, a discussion of the taxonomy, details on the wood anatomy and pollen morphology of the included genera, and a short discussion on uses. The wood anatomy and pollen morphology sections are contributed by Pieter Baas and Raymond van der Ham respectively.

As would be expected from these authors, all content is logically and clearly presented. The main part of the work comprises the key to genera and accounts of each of the genera. The treatment for each genus includes a description of the genus, keys to the species, notes on morphology in some cases, and a description of each species – the standard fare of a Flora account. For *Lagerstroemia*, keys are presented for both flowering and fruiting material. There are two colour plates and a number of expertly drawn illustrations, mostly by Jan van Os.

The largest genera are *Lagerstroemia* (14 species), *Rottala* (8 species) and *Ammania* (7 species). *Cuphea*, with all species introduced from the New World, is represented by six species. The native species are treated in detail. The naturalised

species are treated in less detail but still sufficiently to ensure a positive identification.

One small criticism and that is that in the nomenclatural sections I suspect there has been some overuse of the term 'holotype', particularly for many nineteenth century names that should rather be lectotypified. For the genera previously treated in other families, I also would have liked to have seen them entirely included again here, even if just copied from the previous content with acknowledgement. The number of additional species is not great and it would have made the new treatment here more complete.

As is well known, *Flora Malesiana* has struggled to maintain a consistent output of volumes. This is a reflection of the lack of taxonomists working on basic biodiversity inventory in Southeast Asia as institutions, particularly in Europe, reduce their commitment to such ambitious projects. This new *Flora Malesiana* volume is a great testament to the hard work and tenaciousness of Willem de Wilde and Brigitta Duyfjes, but let us also hope that future volumes will be more frequent, contain more families, and attract accounts from the best and brightest of botanists who understand that taxonomic inventory is as vital today as it was when *Flora Malesiana* first began over 60 years ago.

### Reference

Baas, P., Veldkamp, J.F. & van Welzen, P.C. (2016). On the 80th birthdays of Willem J.J.O. de Wilde and Brigitta E.E. Duyfjes. *Blumea* 61: 85–86.

**David J. Middleton**

*Singapore Botanic Gardens*

# The Gardens' Bulletin Singapore

---

**VOL. 68 2016**

**ISSN 0374-7859**

## **VOLUME 68**

No. 1 pages 1–174 (printed version published 20 May 2016 )

No. 2 pages 175–328 (printed version published 15 November 2016)

# THE GARDENS' BULLETIN, SINGAPORE

The *Gardens' Bulletin, Singapore* is a peer-reviewed journal publishing *original papers* and *reviews* on a wide range of subjects: plant taxonomy (including revisions), phytogeography, floristics, morphology, anatomy, as well as horticulture and related fields, such as ecology and conservation, with emphasis on the plant life of the Southeast Asian-Pacific region.

Dr David J. Middleton      Dr Jana Leong-Škorničková  
(Editor-in-Chief)              (Managing Editor)

Felicia Tay                      Yee Wen Low                      Christina Soh  
(Graphics Editors)              (Copy Editor)                      (Business Manager)

## Editorial Advisory Board

Professor Sir Peter Crane  
*Yale University*  
*U.S.A.*

Dr Rogier P.J. de Kok  
*Honorary Research Associate*  
*Singapore Botanic Gardens*

Dr W. John Kress  
*National Museum of Natural History*  
*Smithsonian Institution*  
*U.S.A.*

Dr Mark Hughes  
*Royal Botanic Garden Edinburgh*  
*U.K.*

Dr Kiat W. Tan  
*Gardens By The Bay*  
*Singapore*

Dr Nigel P. Taylor  
*Singapore Botanic Gardens*  
*National Parks Board, Singapore*

Dr Ian M. Turner  
*Royal Botanic Gardens Kew*  
*U.K.*

Dr Jan-Frits Veldkamp  
*National Biodiversity Center*  
*The Netherlands*

Dr Jun Wen  
*National Museum of Natural History*  
*Smithsonian Institution*  
*U.S.A.*

Professor Nianhe Xia  
*South China Institute of Botany*  
*P.R. China*

Published twice yearly by the National Parks Board, Singapore, the annual subscription for the journal is Singapore \$100.00 including postage. Overseas subscribers should make payment in the form of bank draft or international money order in Singapore currency, payable to *National Parks Board*. Please forward payment to “**Accounts Receivable Section, National Parks Board, Headquarters, Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569**”.

Copyright ©  
**National Parks Board**  
**Singapore Botanic Gardens**  
**1 Cluny Road**  
**Singapore 259569**

Printed by **Oxford Graphic Printers Pte Ltd**



# CONTENTS OF VOLUME 68 (2016)

VOL. 68 (1), May 2016

**D.J. Middleton**

A revision of *Aeschynanthus* (Gesneriaceae)  
in Singapore and Peninsular Malaysia ..... 1

**I.M. Turner**

Notes on the Annonaceae of the Malay Peninsula ..... 65

**K.M. Wong, A.K. Muhammad Ariffin & A.A. Joffre**

Novitates Bruneienses, 5. *Polyalthia watui* (Annonaceae),  
a new tree species from Brunei, Borneo ..... 71

**D. Girmansyah**

Three new species of *Begonia* (Begoniaceae)  
from Sumbawa Island, Indonesia ..... 77

**D. Sulistiarini, D. Arifiani & Y. Santika**

New records of Orchidaceae from Bali, Indonesia ..... 87

**R. Kiew**

*Olea luzonica* (Oleaceae), a new name  
for *O. obovata* from the Philippines ..... 97

**T. Phutthai & M. Hughes**

A new species and a new record in *Begonia* sect.  
*Platycentrum* (Begoniaceae) from Thailand ..... 99

**J.D. Mood, A.G. Hussain & J.F. Veldkamp**

The resurrection of *Boesenbergia albosanguinea* (Zingiberaceae)  
with a new record for Peninsular Thailand ..... 109

**J.D. Mood, H.Đ. Trần, J.F. Veldkamp & L.M. Prince**

*Boesenbergia siphonantha* (Zingiberaceae),  
a new record for Thailand and Vietnam  
with notes on the molecular phylogeny ..... 125

**F. Wen, T.V. Do, X. Hong, S. Maciejewski & Y.G. Wei**

*Boeica ornithocephalantha* (Gesneriaceae),  
a new species from northern Vietnam ..... 139

**M. Möller, K. Nishii, H.J. Atkins, H.H. Kong, M. Kang,  
Y.G. Wei, F. Wen, X. Hong & D.J. Middleton**

An expansion of the genus *Deinostigma* (Gesneriaceae) ..... 145

**J.F. Veldkamp**

The valid publication of *Monolophus* (Zingiberaceae) revisited ..... 173

<b>M. Rodda, N. Simonsson Juhonewe &amp; D.J. Middleton</b> The taxonomic status of the presumed extinct Singaporean <i>Hoya wallichii</i> (Apocynaceae: Asclepiadoideae) .....	175
<b>R.P.J. de Kok, S. Sengun &amp; G.L.C. Bramley</b> Two new records for the Lamiaceae of Singapore .....	189
<b>R.P.J. de Kok</b> Notes on the monotypic genus <i>Hexapora</i> (Lauraceae), endemic to Peninsular Malaysia .....	201
<b>J. Leong-Škorničková &amp; R. Kiew</b> <i>Hanguana fraseriana</i> (Hanguanaceae), a new species from Peninsular Malaysia .....	209
<b>T.L. Yao</b> Nomenclatural updates and new records in Peninsular Malaysian Pentaphylacaceae .....	215
<b>R. Kiew</b> <i>Impatiens</i> (Balsaminaceae) species from karst limestone in Kelantan, Malaysia, including three new species .....	225
<b>R. Kiew, S. Julia &amp; C.Y. Ling</b> The Calcareae group of <i>Begonia</i> (Begoniaceae) from Borneo, including four new species from Sarawak .....	239
<b>S. Julia &amp; R. Kiew</b> Eight new <i>Begonia</i> (Begoniaceae) species from the Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park, Sarawak, Borneo .....	257
<b>N.K.E. Undaharta &amp; W.H. Ardi</b> Studies on <i>Begonia</i> (Begoniaceae) of the Moluccas III: A new <i>Begonia</i> from Seram, Indonesia .....	279
<b>J. Leong-Škorničková, Q.B. Nguyễn, H.Đ. Trần &amp; E. Závěská</b> <i>Etilingera poulsenii</i> and <i>Hornstedtia bella</i> (Zingiberaceae: Alpinieae), two new species from central Vietnam .....	287
<b>J.D. Mood, N. Tanaka, M.M. Aung &amp; J. Murata</b> The genus <i>Boesenbergia</i> (Zingiberaceae) in Myanmar with two new records .....	299
<b>K. Karthigeyan, M. Das Das &amp; L.S. Wijedasa</b> <i>Memecylon cerasiforme</i> (Melastomataceae): a poorly known species rediscovered, redescribed and newly recorded for India .....	319

**BOOK REVIEW**

Flora Malesiana, series I – Seed Plants. Volume 22: Lythraceae.

W.J.J.O. de Wilde & B.E.E. Duyfjes. P.C. van Welzen (Ed.) 2016.

(D.J. Middleton) ..... 327

