



Three new species of *Begonia* (Begoniaceae) from Limestone Hills in southwestern Sarawak, Borneo

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ABSTRACT: Most species of *Begonia* in Borneo, like those of other areas, are narrowly distributed and site-specific. In this study we report three new species of *Begonia*, namely *B. felis* C. W. Lin & C.-I Peng, *B. kuchingensis* C. W. Lin & C.-I Peng (sect. *Petermannia*) and *B. serianensis* C. W. Lin & C.-I Peng (sect. *Reichenheimia*) from the Padawan-Serian limestone hills in southwestern Sarawak. In addition to the taxonomic account, color plates, line drawings, a distribution map, and comparisons with phenetically similar species are provided to aid in identification.

KEY WORDS: *Begonia felis*, *Begonia kuchingensis*, *Begonia serianensis*, Borneo, New species, Sarawak.

INTRODUCTION

In Borneo most species of *Begonia* are narrowly distributed with the great majority confined to a single locality (Kiew *et al.*, 2015). New species continued to be discovered and reported recently (Julia *et al.*, 2015a, b, 2016; Julia & Ling, 2015; Lin *et al.*, 2014a, b, 2015). Limestone hills in Kuching Division occur in Bau, Penrissen, and Padawan-Serian areas, and are tower karst formations with sheer cliffs (Brenda *et al.*, 2004; Kiew & Julia, 2007). In this study we report three new species of *Begonia* from the Padawan-Serian limestone hills (Fig. 1). In addition to the taxonomic account, color plates, line drawings, a distribution map, and comparisons with phenetically similar species are provided to aid in identification.

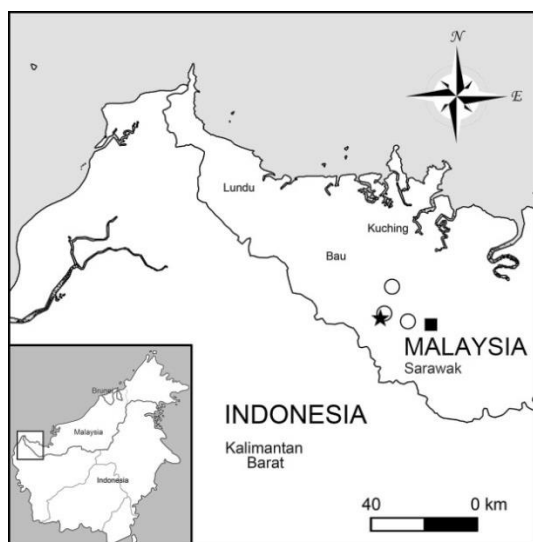


Fig. 3. Distribution map of *Begonia felis* (★), *B. kuchingensis* (○) and *B. serianensis* (■) in Sarawak, Borneo.

TAXONOMIC TREATMENTS

Begonia felis C. W. Lin & C.-I Peng, *sp. nov.*

Sect. *Petermannia*

— **TYPE:** MALAYSIA. Borneo, Sarawak, Kuching Division, Padawan, Gunung Angob, *ca.* 100 m elev. Type specimen pressed from plants cultivated in a nursery, 22 Aug. 2013, C. W. Lin 596 (holotype SAN)

貓城秋海棠 Figs. 1, 2

Plant monoecious, lithophytic, perennial. **Stems** climbing vertically up cliffs, drooping to ascending and shortly erect on upper part, becoming procumbent, many-branched and rooting at lower nodes, to 50 cm long, 2–3.5 mm thick, olive brown to crimson, densely appressed brown-puberulous, internodes 1–3.5 cm long, nodes swollen. **Stipules** pale green, hyaline, ovate-triangular to ovate, 5–8 mm long, 2.5–3.5 mm wide, abaxially minutely hairy and sparsely appressed puberulous on midrib, slightly keeled, margin entire, apex cuspidate, cusp *ca.* 0.5 mm long. **Petioles** terete, 3–13 mm long, *ca.* 2.5 mm thick, brownish red, minutely brown tomentose or glabrescent. **Leaves** slightly oblique, pendent; lamina elliptic to ovate or obovate, sometimes oblanceolate, slightly asymmetric, base slightly unequal, rounded to subcordate or subpeltate, margin undulate or scalloped and acute at vein endings, apex attenuate, 7–13.5 cm long (basal lobes included), 2.5–5 cm wide, broad side 1.4–3 cm wide, adaxially bright green to emerald green with a crimson patch at junction of lamina and petiole, slightly bullate between veins, glabrous, succulent, abaxially pale green, densely appressed puberulous on veins; venation pinnate, midrib 6.6–13 cm long, with *ca.* 3 major lateral veins on each side, other primary veins branching dichotomously; all veins on abaxial surface reddish and prominent. **Bracts** at basal node of inflorescence pale

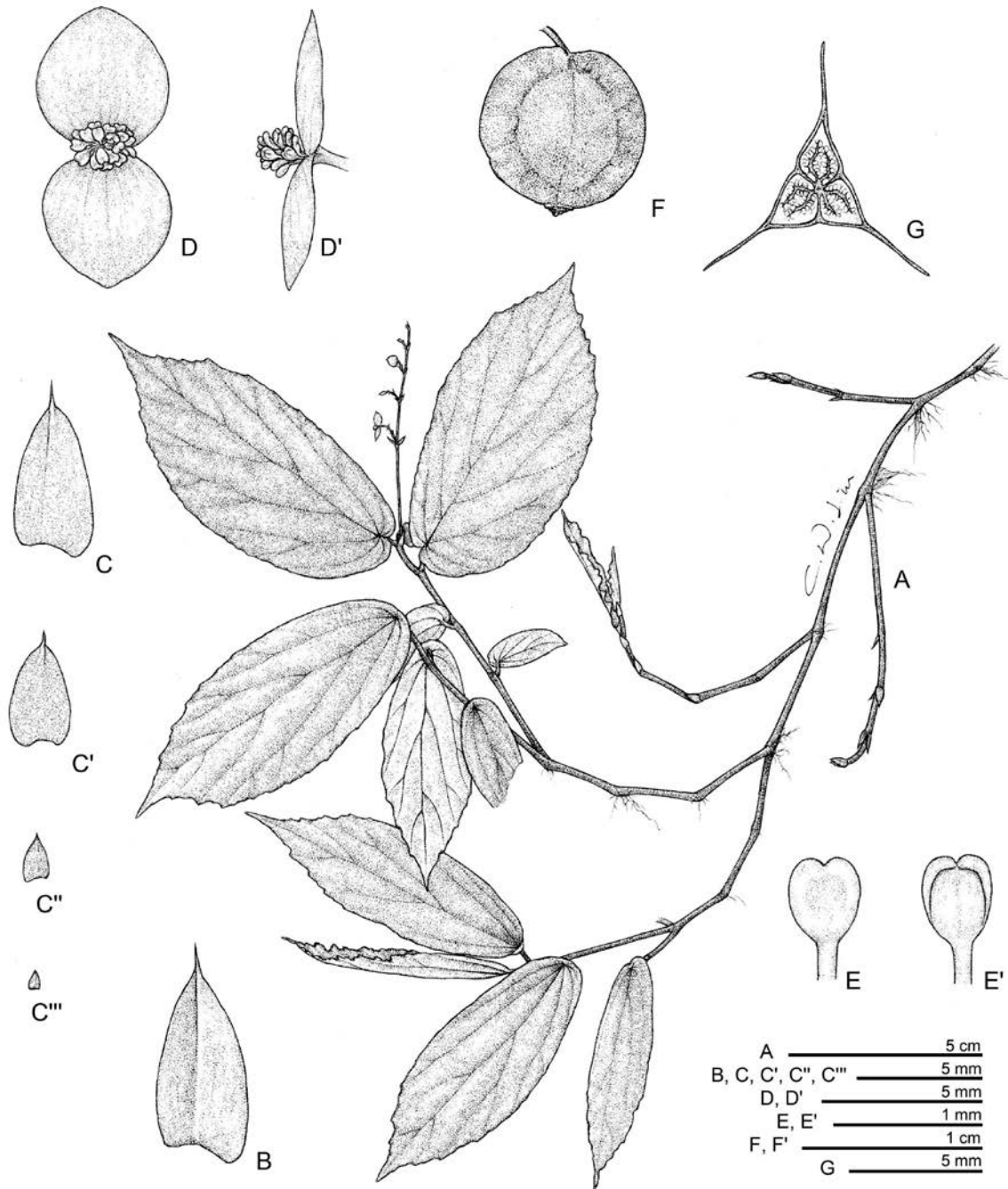


Fig. 1. *Begonia felis* C.W. Lin & C.-I Peng. **A.** Habit; **B.** Stipule; **C, C', C'', C'''**. Bracts from lowermost to uppermost parts of inflorescence; **D, D'**. Staminate flower, face and side views; **E, E'**. Stamen, dorsal and ventral views; **F.** Fruit; **G.** Cross section of an immature fruit; **I.** Fruit.

green to reddish, ovate to ovate-triangular, *ca.* 5 mm long, 3 mm wide, abaxially glabrous or sparsely appressed puberulous on midrib, margin entire, persistent, those at apex of inflorescence similar but smaller, 1–4 mm long, 0.5–2.5 mm wide. **Inflorescence** a cymosely branching panicle to 6 cm long, terminal, bisexual, rachis pale olive to crimson, appressed brown-puberulous; staminate inflorescence a

racemose cyme, peduncle 1–2.5 cm long, with up to 3 orders of branching, erect or ascending; pistillate flowers 1 or 2 on a subsessile peduncle arising from lower part of the inflorescence; protogynous. **Staminate flower:** pedicel 2.5–4 mm long, glabrous or sparsely appressed puberulous, tepals 2, white to pale pink, very widely ovate to orbicular, 3–4 mm across, margin entire, apex acute to rounded; androecium

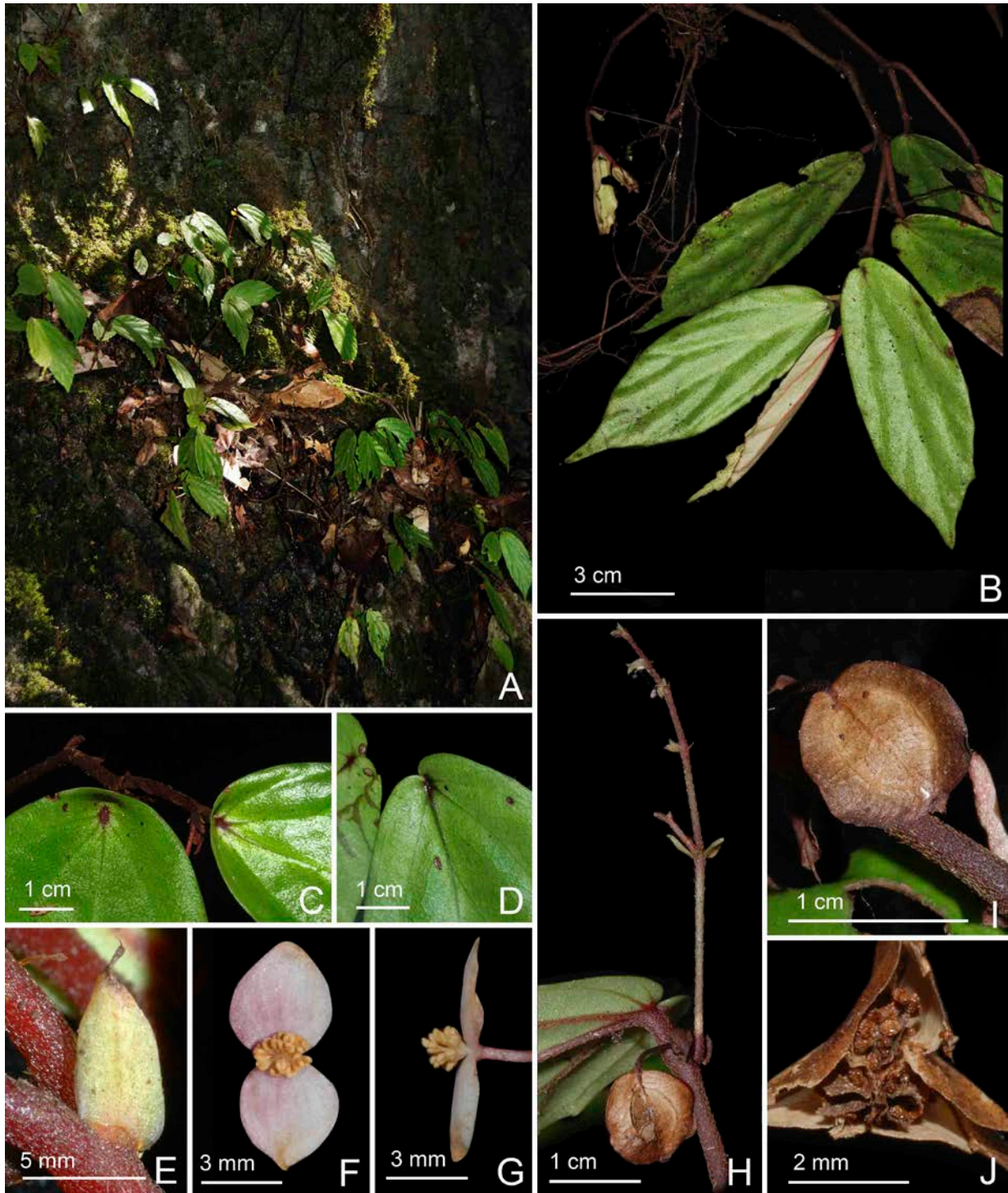


Fig. 2. *Begonia felis* C.W. Lin & C.-I Peng. **A.** Habit and habitat; **B.** Habit; **C.** Portion of leaf, showing subpeltate leaf base; **D.** Portion of leaf, showing basifixed leaf; **E.** Stipule; **F.** Staminate flower, face view; **G.** Staminate flower, side view; **H.** Old inflorescence with a mature fruit; **I.** Fruit; **J.** Cross section of mature fruit.

actinomorphic, stamens *ca.* 20, filaments subequal, slightly fused at base; anthers very widely obovate, apex retuse, *ca.* 0.5 mm long, equal or longer than filaments. **Pistillate flower:** not seen. **Fruit** recurved horizontally, pedicel *ca.* 5 mm long, capsule body

globose, *ca.* 1 cm across (wings included), sparsely appressed puberulous, 3-locular, placentae bilamellate; wings 3, subequal, crescent-shaped, rounded distally, rounded or subcordate proximally, *ca.* 1 cm long, 2–3 mm wide.



Distribution and ecology: Endemic to Padawan, Sarawak, Borneo (Fig. 3). On deeply shaded limestone cliffs, elevation *ca.* 100 m.

Etymology: The epithet "*felis*" refers to Kuching (literally "cat" in Malay), where the new species was discovered.

Notes: *Begonia felis* superficially resembles *B. juliasangii* Kiew (Kiew and Julia ["Kiew and Sang"], 2009) in having scarcely peltate, elliptic to obovate lamina, which is quite unique for Bornean limestone begonias. The new species markedly differs in the drooping (vs. creeping, appressed to the substrate) and densely appressed puberulous (vs. glabrous) stem, petiole appressed tomentose (vs. clothed with erect, translucent long hairs), inflorescence terminal (vs. axillary) and racemose-cyme (vs. cymose), tepals of staminate flower 2 (vs. 4), placentae bilamellate (vs. undivided), fruits with short, rounded, crescent-shaped wing (vs. slightly pointed distally, narrowly triangular). *Begonia felis* is a member of sect. *Petermannia* whereas *B. juliasangii* belongs to sect. *Reichenheimia*.

Proposed conservation status: There is not adequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. Following the Red List criteria of the IUCN (2012), we consider *Begonia felis* as Data Deficient (DD).

Begonia kuchingensis C. W. Lin & C.-I Peng, *sp. nov.*
Sect. *Petermannia*

— **TYPE:** MALAYSIA. Borneo, Sarawak, Kuching Division, Padawan, Gunung Angob, *ca.* 100 m elev. Type specimen pressed from plants cultivated in a nursery, 22 Aug. 2013, C. W. Lin 552 (holotype SAN)

古晉秋海棠 Figs. 4, 5; Tab. 1

Plant monoecious, lithophytic, perennial. **Stems** erect or ascending, rooting at lower nodes, 30–65 cm tall, 4–7(–12) mm thick, olive brown to crimson, densely velutinous, internodes 1.5–4(–8) cm long, nodes swollen. **Stipules** pale green or reddish, hyaline, ovate-triangular to widely ovate, 1–2.5 cm long, 0.7–1.5 mm wide, abaxially densely minutely puberulous and sparsely velutinous, strongly keeled, margin entire or sparingly puberulous, apex cuspidate. **Petioles** terete, 3–8 cm long, *ca.* 2.5 mm thick, crimson, densely velutinous. **Leaves** oblique, more or less pendent; lamina ovate to widely ovate, basifixed, strongly asymmetric with a well-developed basal lobe on one side giving a cordate appearance, margin dentate to denticulate, apex acuminate or shortly caudate, 15–25 cm long (basal lobes included), 7–13.5 cm wide, broad side 5–9.5 cm wide, base unequal, basal lobes cordate, 1–4 cm long, succulent, adaxially dark green to emerald green, venation crimson towards base, slightly bullate between veins, hispid, hairs *ca.* 1 mm long, adaxially sometimes iridescent and appearing bluish; abaxially

pale green; venation palmate-pinnate, midrib distinguishable, 14–21 cm long, with *ca.* 4 major lateral veins on either side of midrib, other primary veins branching dichotomously, all venation reddish and prominently raised abaxially. **Bracts** at basal node of inflorescence pale green to reddish, ovate-triangular, *ca.* 1.7 cm long, 1 cm wide, abaxially minutely puberulous and velutinous, margin entire; those at apex of inflorescence in staminate flowers suborbicular, 2.5–5 mm across. **Inflorescence** a cymosely branching panicle 5–10 cm long, terminal, bisexual, densely velutinous; peduncle up to 3 cm long, staminate inflorescence a racemose cyme, erect or ascending, terminal, crimson, densely velutinous; pistillate flowers up to 4, *ca.* 0.7–2 cm apart, produced singly from short peduncle (sometimes sessile) in the lower part of the inflorescence; protogynous. **Staminate flower:** pedicel 2.5–5 mm long, tomentose, tepals 2, pale pink to rose pink, widely ovate to orbicular, 4–6 mm long, 3.5–5.5 mm wide, abaxially minutely puberulous, margin entire or sparsely puberulous, apex rounded; androecium actinomorphic, stamens *ca.* 45, filaments subequal, fused at base; anthers very widely obovate, apex truncate or retuse, *ca.* 1 mm long, equal or longer than filaments. **Pistillate flower:** pedicel *ca.* 4 mm long, puberulous; ovary pale green tinged red, body trigonous-ellipsoid, *ca.* 6 mm long, 3 mm across, puberulous, 3-winged; wings rounded to base, truncate or rounded distally, 7–10 mm long, 1.5–3 mm wide; ovary 3-locular, placenta bilamellate; tepals 5 (sometimes 4), pale green, tinged reddish towards, outer tepals widely ovate to oblong, *ca.* 8 mm long, 5 mm wide, abaxially minutely puberulous; inner tepals similar but glabrous, margin denticulate; styles 3, yellow, bifid, *ca.* 4 mm long; stigmas in a spiral band and papillose all around. **Fruit** recurved horizontally, pedicel 8–16 mm long, capsule 1.4–2.2 cm long, 1.1–1.6 cm across (wings included), puberulous, 3-locular, placentae bilamellate; wings 3, subequal, trapezoid, rounded or truncate distally, rounded proximally.

Distribution and ecology: Endemic to Penrissen-Padawan and Serian areas, Sarawak, Borneo (Fig. 3). On steep slope at base of limestone hills or lower cliffs and about entrance of limestone caves, elevation 50–300 m.

Etymology: Named for its locality, Kuching Division, where the new species is common in southern limestone hills.

Notes: *Begonia kuchingensis* resembles *B. corrugata* Kiew & S. Julia (Kiew and Julia, 2007), which could be easily confused in herbarium specimens and young live plants. Both species are members of sect. *Petermannia*, distributed in Padawan area in Kuching Division, have ovate, bullate, hairy lamina, 2-tepalled staminate flowers and 5-tepalled pistillate flowers. *Begonia kuchingensis*, however, is sharply distinct from

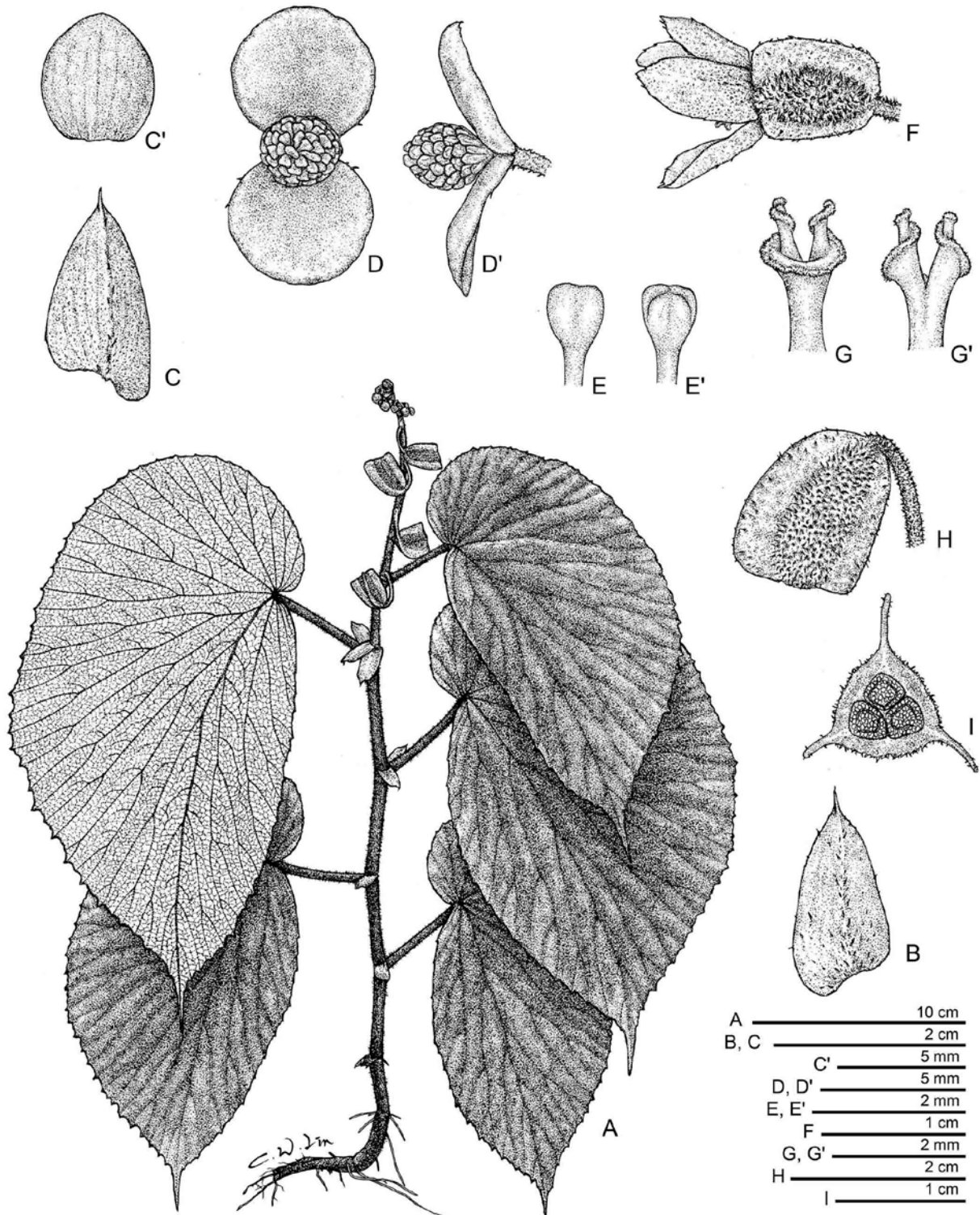


Fig. 4. *Begonia kuchingensis* C.W. Lin & C.-I Peng. **A.** Habit; **B.** Stipule; **C, C'.** Bracts from lowermost and uppermost parts of inflorescence; **D, D'.** Staminate flower, face and side views; **E, E'.** Stamen, dorsal and ventral views; **F.** Pistillate flower; **G, G'.** Style, ventral and dorsal views; **H.** Fruit; **I.** Cross section of an immature fruit.

B. corrugata (Fig. 6) in having taller, erect stems, sparsely hispid leaves, leaf upper side bluish iridescent in immature plants, pistillate flowers singly on

peduncle in lower part of inflorescence. The new species is also similar to *B. congesta* Ridl. (Ridley, 1906), that is endemic to Bau area in Kuching Division.

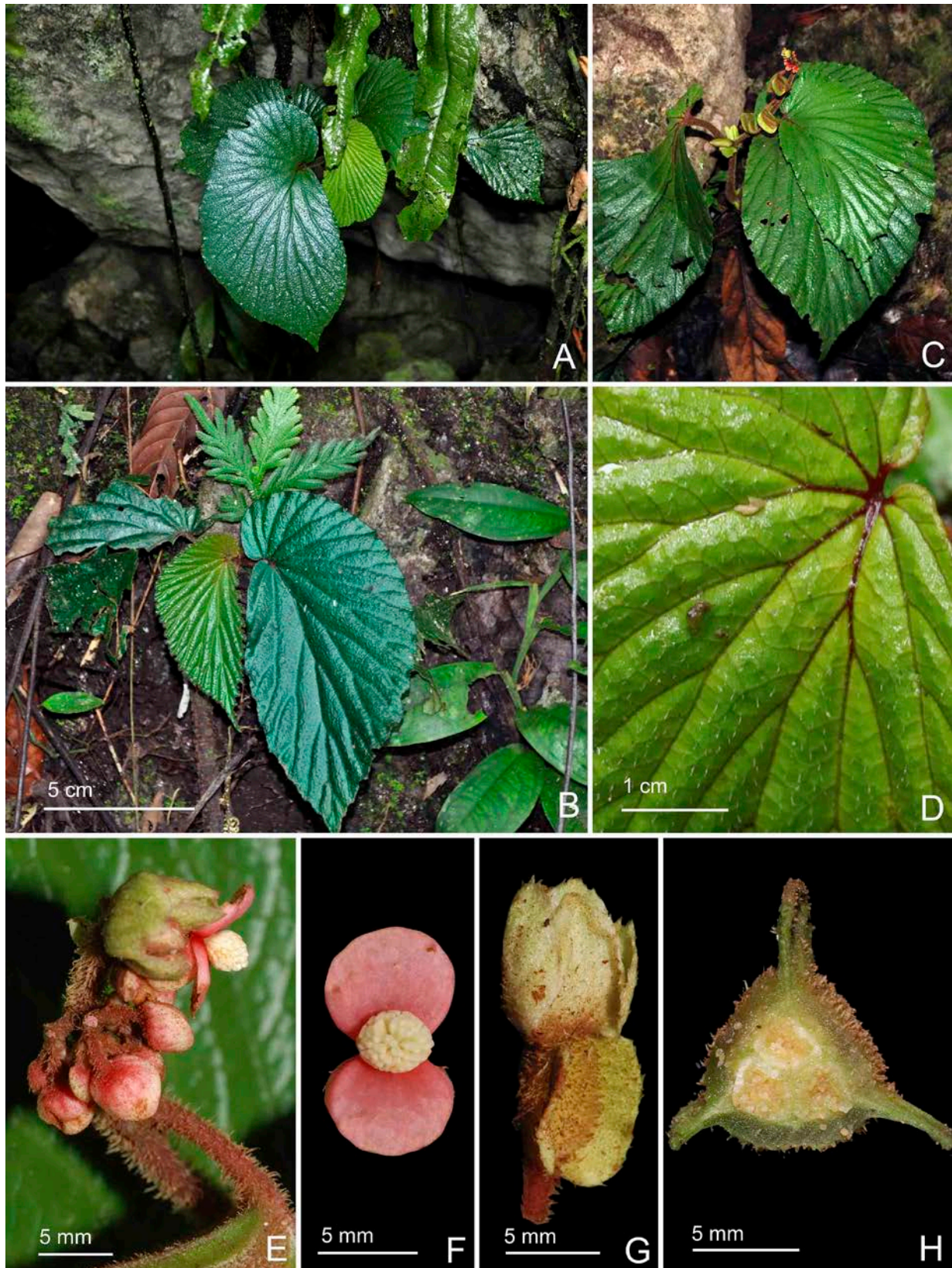


Fig. 5. *Begonia kuchingensis* C.W. Lin & C.-I Peng. **A.** Habit and habitat, **B.** Same, showing slightly bluish iridescent leaves of an immature plant, **C.** Flowering plant; **D.** Portion of leaf, showing hispid hairs; **E.** Inflorescence, upper part with staminate flowers; **F.** Staminate flower, face view; **G.** Pistillate flower, side view; **H.** Cross section of immature fruit.

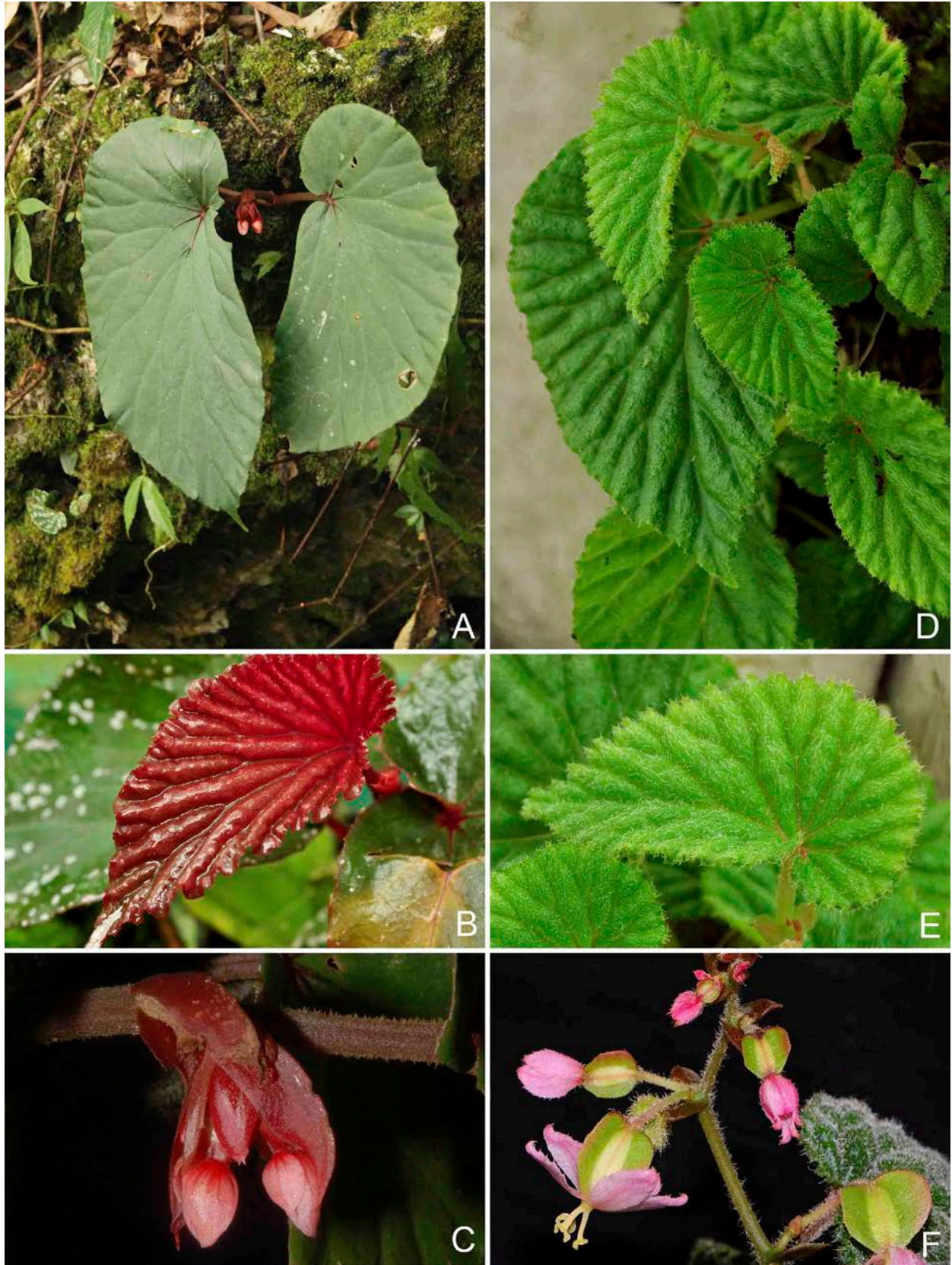


Fig. 6. *Begonia congesta* Ridl. (A-C). **A.** Habit and habitat; **B.** Immature plant, showing subglabrous upper side with white spots; **C.** Inflorescence. *Begonia corrugata* Kiew & S. Julia (D-F). **D.** Leaf, showing densely tomentose upper side; **F.** Inflorescence.

**Table 1.** Comparison of *Begonia kuchingensis* C. W. Lin & C.-I Peng, with *B. congesta* Ridl. and *B. corrugata* Kiew & S. Julia.

	<i>B. kuchingensis</i> (Figs. 4, 5)	<i>B. congesta</i> (Based on observation of living plants and literature)	<i>B. corrugata</i> (Based on observation of living plants and literature)
Habitat	mainly on soil slope or rock-strewn at base of limestone hills	at base of cliffs or crevices of limestone hills	on vertical face of limestone cliffs
Habit	erect or ascending	erect or ascending	climbing, shortly erect when flowering
Stem tall (cm)	30–65	to 100	to 20
Leaf adaxial surface			
color in immature plants	with bluish iridescent, lacking maculation	with white spots maculation; lacking iridescence	uniformly green, lacking iridescent and maculation
vestiture	sparsely hispid	glabrous or very sparsely minutely scabrescent in young plants	densely tomentose
texture	slightly bullate	nearly flat	strongly bullate
Inflorescence	longer than petiole	shorter than petiole	longer than petiole
Bract vestiture	minutely puberulous	glabrous	minutely puberulous
Staminate flower No. of stamens	ca. 45	ca. 25	10–20
Pistillate flower tepals margin	singly denticulate	in pairs entire	singly or in pairs denticulate
ovary	puberulous	glabrous	bristly
Geographical Distribution	Penrissen-Padawan and Serian	Bau	Padawan-Tebedu

A comparison of *B. kuchingensis* with these two phenetically similar species are presented in Table 1.

Proposed conservation status: There is not adequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. Following the Red List criteria of the IUCN (2012), we consider *Begonia kuchingensis* as Data Deficient (DD).

Begonia serianensis C. W. Lin & C.-I Peng, *sp. nov.*

Sect. *Reichenheimia*

— **TYPE:** MALAYSIA. Borneo, Sarawak, Samarahan Division, Serian, Gunung Sanain, ca. 100 m elev. Type specimens pressed from plants cultivated in a nursery, 27 Aug. 2013, C. W. Lin 597 (holotype SAN)

西連秋海棠 Figs. 7, 8

Plant monoecious, lithophytic, perennial. **Rhizome** olive green to reddish, creeping and rooting at nodes, 4–10 cm long, 5–10 mm thick, velutinous, glabrescent, internodes congested. **Stipules** persistent, pale green to tinged reddish, narrowly triangular to ovate-triangular, acuminate at tip, 6–9 mm long, 3–5.5 mm wide, abaxially appressed puberulous, keeled, margin entire, apex long-setose, seta 5–6 mm long. **Petioles** terete, 2.5–5 cm long on upper stem, to 10 cm on lower stem, 4–6 mm thick, reddish, densely woolly, glabrescent. **Leaves** nearly appressed to substrate and assuming a rosette appearance, 3–10, slightly asymmetric, lamina orbicular to reniform, peltate, subpeltate to basifixed, 7–13 cm long, 7–13.5 cm wide, broad side to 8 cm

wide, margin entire to denticulate, reflexed, villous, apex rounded, adaxially green to pale green, slightly bullate between palmate veins, glabrous, succulent, abaxially pale to reddish, villous on veins, midrib distinguishable, 6.5–12.5 cm long, with ca. 2 major lateral veins on each side, other primary veins branching dichotomously or nearly so, tertiary veins reticulate; all venation prominently raised abaxially.

Bract pale yellowish green to pinkish, glabrous or minutely puberulous and with sessile glands adaxially, caducous; those at base of inflorescence ovate-triangular, ca. 3 mm long, ca. 2.5 mm wide, margin entire, apex setose, seta ca. 1 mm long, those at apex of inflorescence widely triangular, 0.8–2 mm long, 1–2.3 mm wide, margin entire, apex attenuate.

Inflorescence bisexual, in cymosely branching panicles, 1–4 arising from nodes on rhizome, pale green to reddish, sparsely villous, 4.5–14 cm long, peduncle 2.8–11 cm long; protandrous. **Staminate flower:** pedicel 4–12 mm long, sparsely villous, tepals 4, pale pink to white, abaxially glabrous or sparsely velutinous, margin entire, outer two widely elliptic to widely obovate, 7–11 mm long, 6.5–9 mm wide, apex acute to obtuse, inner two narrowly elliptic to widely oblanceolate, 6–9 mm long, 2–3 mm wide; androecium zygomorphic, stamens 25–35, filaments slightly fused at base; anther ca. 1.5 mm long, subequal to filament. **Pistillate flower:** pedicel ca. 5 mm long, glabrous or velutinous; ovary reddish to pale yellow green, glabrous or sparsely glandular; ovary body

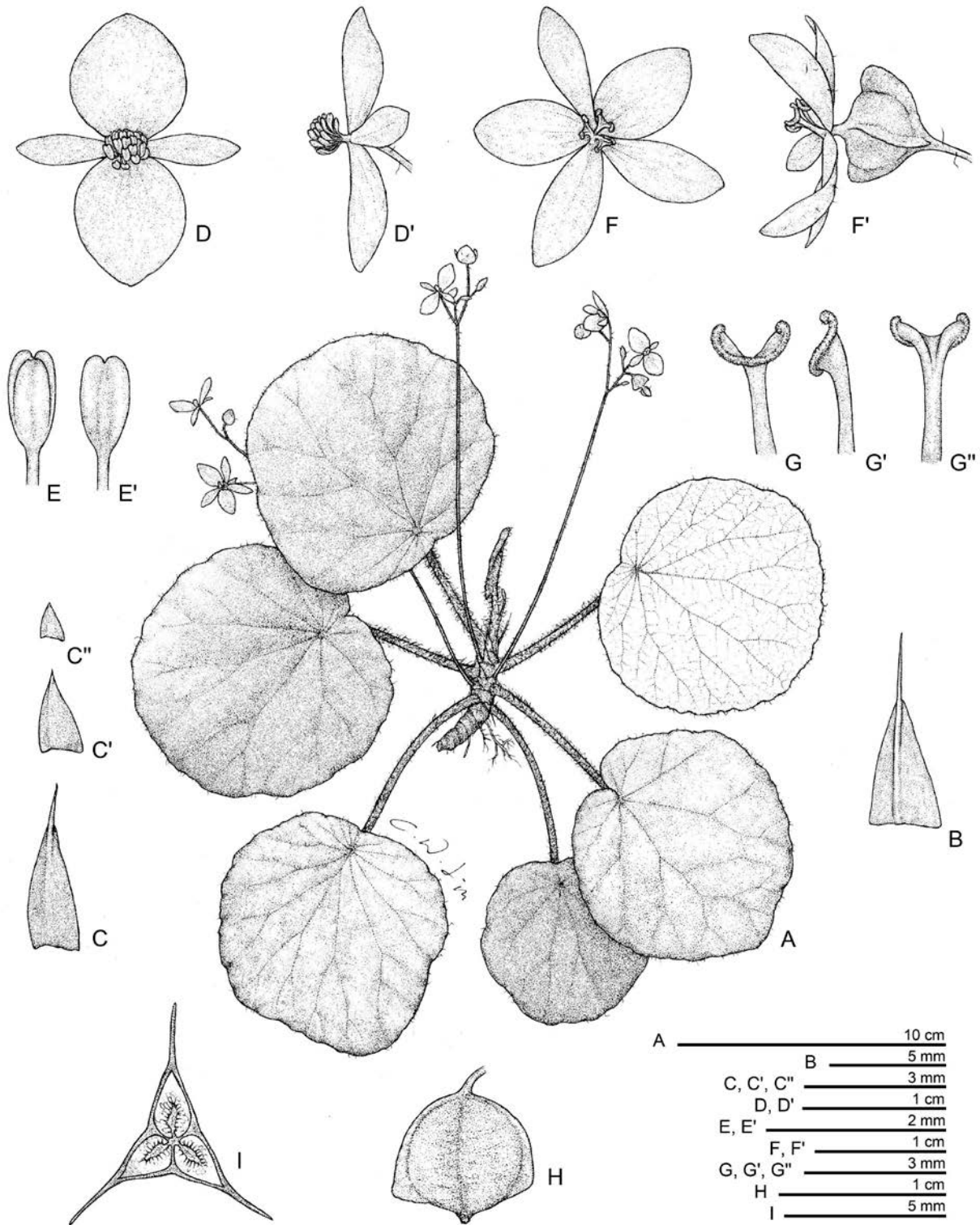


Fig. 7. *Begonia serianensis* C.W. Lin & C.-I Peng. **A.** Habit; **B.** Stipule; **C, C', C''.** Bract progressively smaller from lower to upper part of inflorescence; **D, D'.** Staminate flower, face and side views; **E, E'.** Stamen, ventral and dorsal views; **F, F'.** Pistillate flower, face and side views; **G, G', G''.** Style, dorsal, side and ventral views; **H.** Fruit; **I.** Cross section of immature fruit.

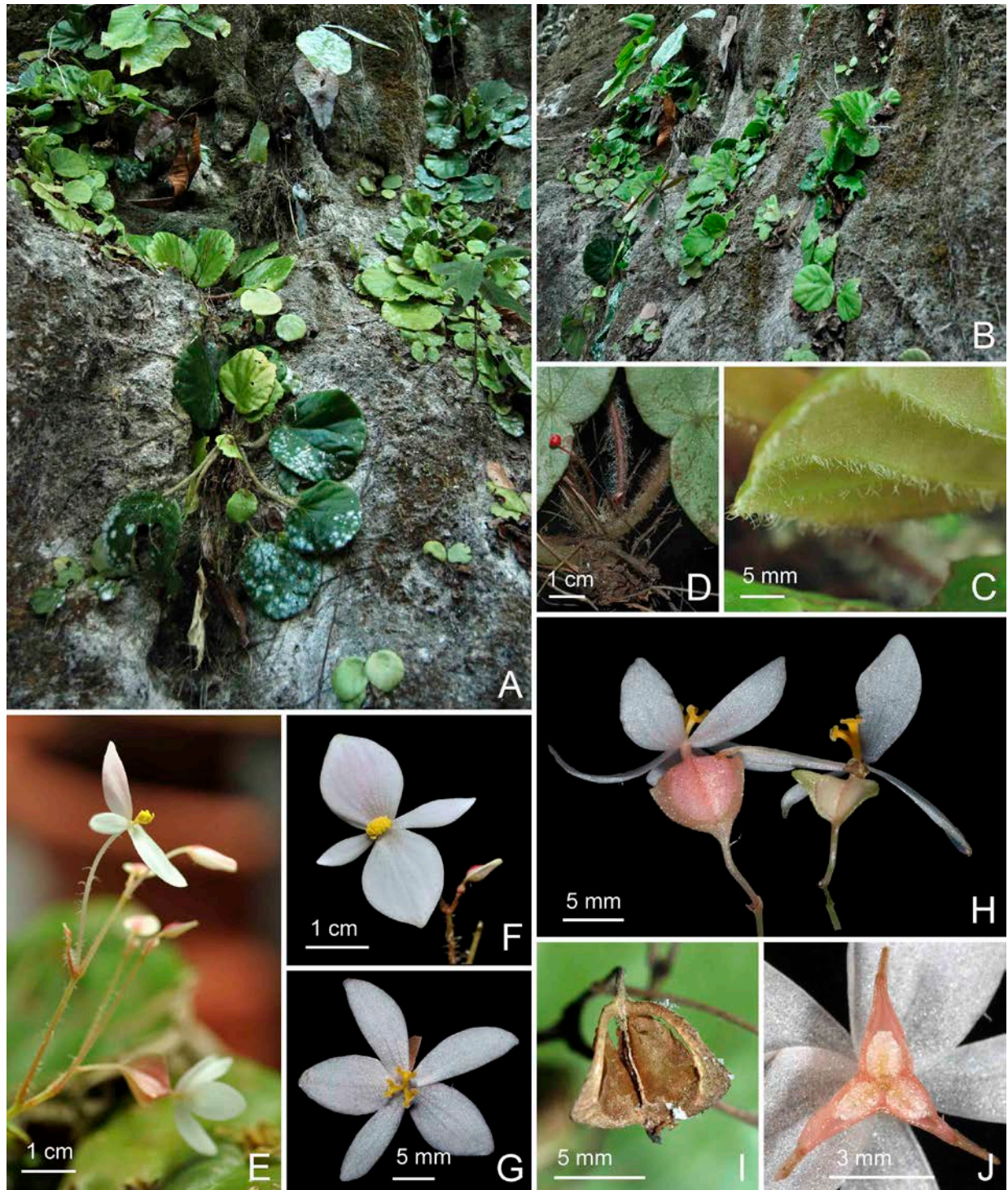


Fig. 8. *Begonia serianensis* C.W. Lin & C.-I Peng. **A, B.** Habit and habitat; **C.** Portion of leaf, showing densely villous veins on the underside; **D.** Portion of leaves, showing peltate and basifixed leaves with villous petioles; **E.** Inflorescence; **F.** Staminate flower, face view; **G.** Pistillate flower, face view; **H.** Pistillate flowers, side view; **I.** Dehiscent fruit; **J.** Ovary, cross section.

trigonous-ellipsoid, 3–5.5 mm across, 3-winged; wings subequal, reddish, triangular to narrowly crescent-shaped, rounded at tip, narrowed to base, sometimes not confluent at apex, 4–6.5 mm long, 1–2 mm wide; ovary 3-locular, placenta undivided; tepals 5,

pinkish to white, abaxially glabrous or sparsely velutinous, outer 2 tepals ovate to elliptic, 8–11 mm long, 4–5.5 mm wide, inner tepals 3, oblanceolate to narrowly elliptic, apex acute, 6.5–12 mm long, 2–4 mm wide; styles 3, yellow, bifid, ca. 3.5 mm long, C-shaped



and apically slightly split; stigmas in a spiral band and papillose all around. **Fruit** pendent on a stalk *ca.* 6 mm long, capsule 5.5–7.5 mm long, 6–8.5 mm thick (wings included), wings subequal, narrowed to the base, rounded distally.

Distribution and ecology: Endemic to limestone cliffs around Serian, Sarawak, Borneo (Fig. 3). On vertical cliff face or rooting in soil at cliff base, at margin of dipterocarp forest, elevation 50–150 m.

Etymology: The epithet refers to Serian District, where the new species was discovered.

Notes: The new species resembles *B. speluncae* Ridl. (Ridley, 1906), also a member of sect. *Reichenheimia*, in having scarcely peltate leaves, but is distinguishable by the petioles and leaf underside densely villous along veins (vs. glabrous); much larger lamina 7–13 × 7–13.5 (vs. 1.3–5 × 1.5–5.5) cm; inflorescence velutinous (vs. glabrous), smaller pistillate tepals (6.5–11 × 2–5.5 vs. 12–15 × 6–8 mm) and smaller fruits (5.5–7.5 × 6–8.5 vs. 8 × 8–11 mm). Geographically, *B. speluncae* is endemic to Kuching Division whereas *B. serianensis* occur in Samarahan Division.

Begonia serianensis is also similar to *B. andersonii* Kiew & S. Julia (Kiew and Julia, 2007) in habit and leaf shape and size, but is distinct in the variably peltate, subpeltate or basifixed (vs. uniformly basifixed) leaves; bracts subglabrous (vs. densely long hairy); and pistillate tepals 5 (vs. 4), outer tepals ovate to elliptic (vs. obovate to wide obovate), larger outer tepals (8–11 × 4–5.5 vs. *ca.* 3 × 3 mm) and inner tepals (6.5–12 × 2–4 vs. *ca.* 2 × 1 mm), shorter fruit pedicels (*ca.* 6 vs. 9–11 mm long) and capsules 5.5–7.5 × 6–8.5 (vs. 4–5 × 11–13) mm, wings triangular to narrowly crescent-shaped (vs. widely triangular).

Proposed conservation status: There is not adequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. Following the Red List criteria of the IUCN (2012), we consider *Begonia serianensis* as Data Deficient (DD).

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