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.

**TAXONOMIC TREATMENTS**

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

Sect. *Petermannia*

—**TYPE:** MALAYSIAS. 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)

*Plant monoeocious, 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 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
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 stamine flower 2 (vs. 4), placenta 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 & C.-I Peng, sp. nov.

Distribution and ecology: Endemic to 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-tepalied staminate flowers and 5-tepalied pistillate flowers. Begonia kuchingensis, however, is sharply distinct from

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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.
A comparison of *B. kuchingensis* with these two phenoetically similar species is 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).

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

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

**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)  

Plant monocious, 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. **Petaloid** 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 denticate, 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. **Staminulate 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 oblong to obovate, 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

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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), 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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**LITERATURE CITED**


