

## FOUR NEW SPECIES OF *BEGONIA* (*BEGONIACEAE*) FROM THAILAND

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Four new species of *Begonia* are described from Northern, Peninsular and Southwestern Thailand. Three belong to *Begonia* sect. *Diploclinium* (*B. exposita* Phutthai & M.Hughes, *B. pengchingii* Phutthai & M.Hughes and *B. pseudosubperfoliata* Phutthai & M.Hughes), and one (*B. phutthaii* M.Hughes) to *Begonia* sect. *Apterobegonia*. All four species are karst limestone endemics. The provisional IUCN status of all the new species is 'Vulnerable'.

*Keywords.* *Apterobegonia*, *Begonia*, *Diploclinium*, new species, Thailand.

### INTRODUCTION

Following extensive field surveys and herbarium-based studies (ABD, BK, BKF, BM, C, E, HAST, K, L, PSU and SING) for the *Flora of Thailand* project, 47 accepted names in *Begonia* L. representing eight sections of the genus were reported in the most recent checklist for Thailand (Phutthai *et al.*, 2009). Eight new species and a new record (Phutthai & Sridith, 2010; de Wilde *et al.*, 2011; Phutthai *et al.*, 2012, 2014; Phutthai & Hughes, 2016; this study) have brought the total to 55 native species.

*Begonia* sect. *Diploclinium* (Lindl.) A.DC. is one of the largest sections of Asian *Begonia*, comprising 116 species (Hughes *et al.*, 2015), and is distributed from the Himalayas to Indochina and Malaysia (Doorenbos *et al.*, 1998). Rhizomatous species from the Philippines previously included in the section have recently been transferred to *Begonia* sect. *Baryandra* A.DC. (Rubite *et al.*, 2013), leaving the section somewhat better defined as a tuberous group with bifid placentae, the bulk of the species being restricted to continental Asia. The section as currently circumscribed is paraphyletic, other species of tuberous sections *Alicida* C.B. Clarke and *Reichenheimia* (Klotzsch) A.DC. being nested within it (Thomas *et al.*, 2011). *Begonia* sect. *Diploclinium* is represented by 15 species in Thailand (Hughes, 2008; Phutthai & Sridith, 2010; Phutthai *et al.*, 2014). Three new species in the section, *Begonia exposita* Phutthai & M.Hughes, *B. pengchingii* Phutthai & M.Hughes and *B. pseudosubperfoliata* Phutthai & M.Hughes, are described here, bringing the number of Thai species in the section to 18. One of the species, *Begonia pseudosubperfoliata*, is aberrant in sect. *Diploclinium* in having a single placental branch per locule. However, classification in a different section

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based on this single, homoplastic character is not desirable (Thomas *et al.*, 2011), and in all other respects it fits comfortably alongside other Thai members of the section.

*Begonia* sect. *Apterbegonia* Warb. was a rather poorly known monotypic section, being based on a description of a single specimen of a single species (Doorenbos *et al.*, 1998), namely *B. delicatula* Parish ex C.B. Clarke. Here we add another species, *Begonia phutthaii* M. Hughes, obviously allied to the type species in habit and leaf shape, and sharing the distinctive narrow wings on the fruit capsule. The new species extends the distribution of the section from Myanmar into Thailand.

#### MATERIALS AND METHODS

The new species were described from observations of living plants in the wild, photographs thereof and herbarium material. Herbarium specimens were examined at first hand when necessary, and also via electronic images from Hughes *et al.* (2015). The placement of the species into the threat categories specified by the International Union for Conservation of Nature (IUCN) was carried out using the criteria in IUCN (2012), based on information from specimens and field observations.

#### SPECIES DESCRIPTIONS

***Begonia exposita* Phutthai & M. Hughes sp. nov.** Sect. *Diploclinium*. **Figs 1, 2.**

The habit resembles that of *Begonia putii* Craib, *B. discreta* Craib and *B. soluta* Craib in terms of the small number of cordate leaves arising directly from a tuber. *Begonia putii* and *B. soluta* differ in being smaller plants, with leaves less than 6 × 6 cm (not up to 15 × 14 cm), and having 4 tepals in the male flowers (not 2). *Begonia discreta* is a more similar size to *B. exposita* but differs in having fewer stamens (c.12, not 40–50) and male flowers with 4 tepals (not 2), and in being a higher altitude species (found at c.1350 m, not c.140 m altitude). *Begonia exposita* further differs from all three species in having succulent leaves (not thin and papery). – Type: Thailand, Sangkhla Buri District. On exposed limestone in direct sunlight area, 15°18'N, 98°23'E, 140 m, 4 x 2009, *T. Phutthai* 222 (holo BKF; iso E, PSU).

Monoecious acaulescent herb, 10–30 cm tall. *Tuber* globose or cordiform, c.5–10 mm in diam., with numerous fibrous roots. *Leaves* unifoliate, lamina basifixed; petiole dark red, pubescent, reddish brown when dry, 9–15 cm long; leaf blade succulent, subcoriaceous, symmetrical, adaxial surface pubescent, glossy light green, abaxial surface pubescent, pale green; ovate, 3–15 × 4–14 cm, base deeply cordate, apex acute, margin serrate and ciliate; venation palmate, veins 12–14, prominent beneath. *Stipules* deciduous. *Inflorescences* arising from tuber, compound cymes, branched up to 4 times, bisexual, 20–30 cm long, staminate flowers basal and pistillate flowers distal, protandrous; peduncles 10–26 cm long, terete, glabrous, dark red, glossy. *Bracts* ovate, margin fimbriate. *Staminate flowers*: pedicels dark red, 3–4 mm long, sparsely hairy, erect or occasionally ascending; tepals 4, white with a pale pink flush inside and outer part darker, bright pink on the reverse; outer 2 suborbicular, c.6 × 6 mm, base rounded,

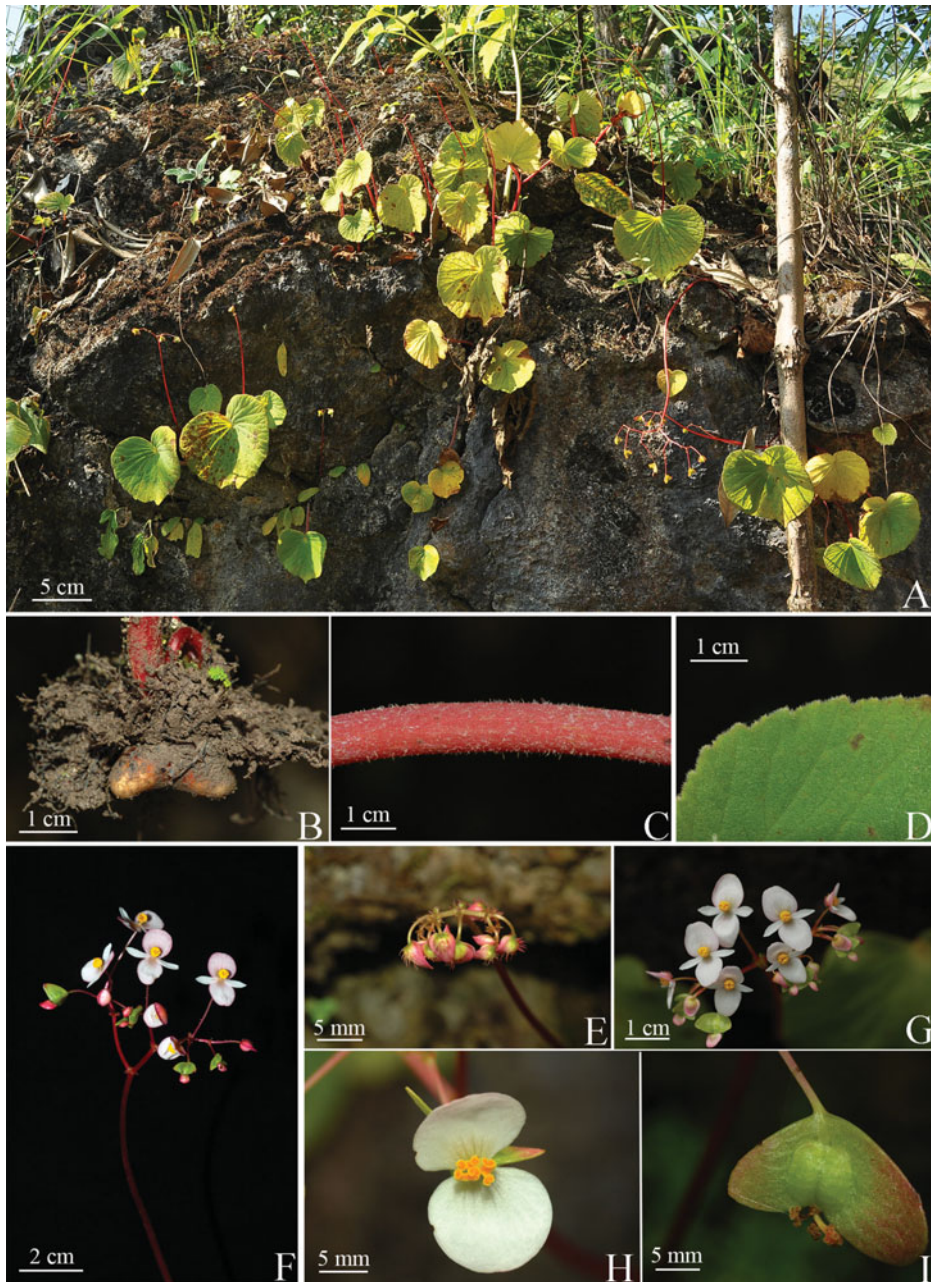


FIG. 1. *Begonia exposita* Phutthai & M.Hughes. A, Habit and habitat of exposed limestone (*Phutthai* 262); B, tuberous stem; C, pubescent hairs on petioles; D, minute pubescent hairs on lamina and leaf margin; E, hairs on bracts and outer tepals; F, inflorescence; G, male flowers; H, female flowers; I, capsule (B–E from *Phutthai* 222).

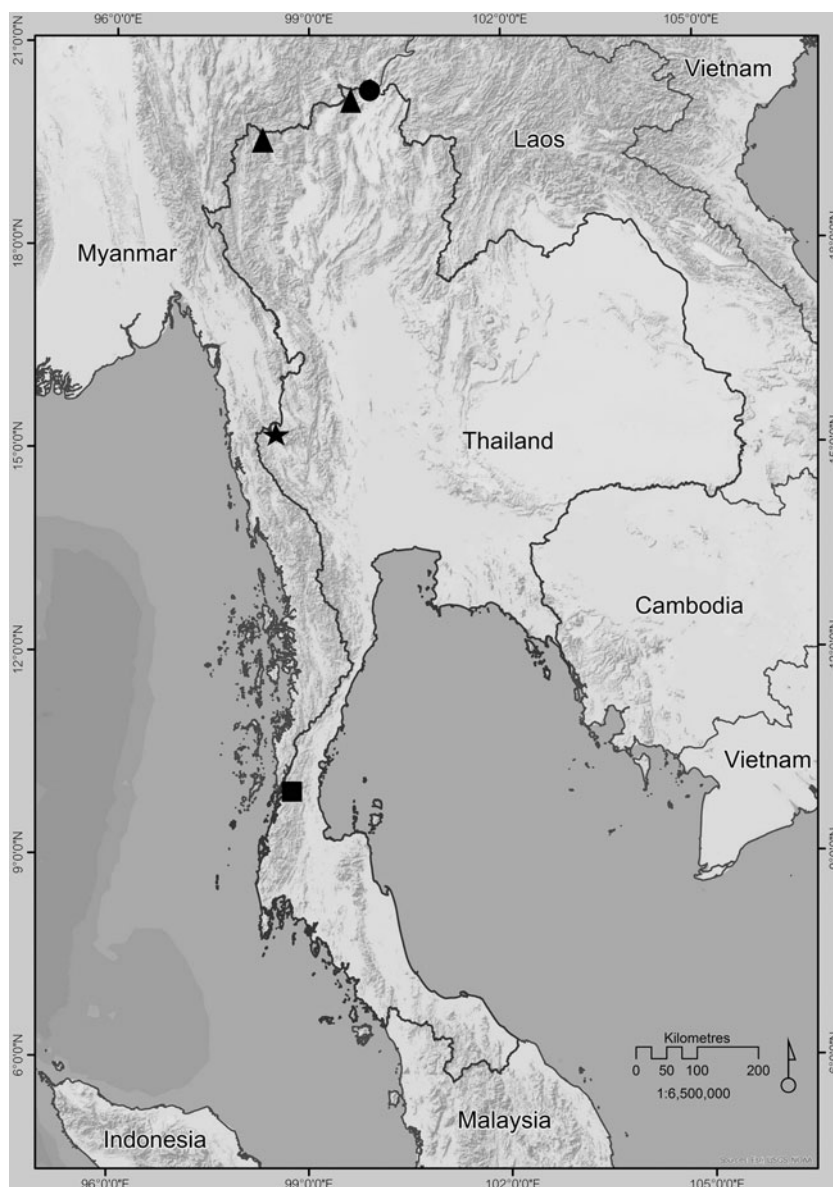


FIG. 2. Distribution of *Begonia phutthaii* (triangles), *B. pengchingii* (circle), *B. pseudosubperfoliata* (square) and *B. exposita* (star).

margin entire, apex rounded, sparsely hairy on the reverse, inner side glabrous, inner 2 narrowly elliptic, c.5 × 2 mm; androecium actinomorphic, globose, stamens 40–50, bright yellow, filaments fused at the base, c.1 mm long, anthers oblong, c.1 mm long, dehiscing by short slits near the tip. *Pistillate flowers*: pedicels pale green, sparsely hairy,

2–3 mm long; tepals 2(or 3), same colour as staminate flower; suborbicular, 5–8 × 5–9 mm, base rounded, margin entire, apex rounded, outer parts sparsely hairy, inner parts glabrous; styles 3, fused at the base, dark yellow, stigmatic band crescent-shaped and minutely papillose; ovary green or pink, with 3 subequal wings; 3-locular, placentation axillary, 2 branches per locule. *Fruits* capsules, glossy, pale green, drying pale brown, 10–15 × 4–5 mm; locules subglobose, 4–5 × 4–5 mm, abaxial wing ligulate with a rounded apex, c.10 mm long, 5–6 mm wide at base, 2 lateral wings deltoid, 2–3 mm long, 5–6 mm wide at base.

*Distribution.* Endemic to Southwestern Thailand, Kanchanaburi Province, Sangkhla Buri District; growing on an inselberg limestone mountain near Three Pagodas Pass between Thailand and Myanmar.

*Habitat and ecology.* On exposed limestone rock crevices at an altitude of 140 m. Flowering May to November; fruiting November to January.

*Notes.* *Begonia exposita* is endemic to Thailand and a very rare species. Only two other *Begonia* species can be found in a similar, exposed limestone habitat in Thailand, namely *B. alicida* and *B. soluta*. This habitat is unusual for *Begonia*, being comparatively hot and dry, especially in the dry season. Such habitats can be found only in the north of the Tenasserim range in Kanchanaburi Province. The species is able to grow only on degraded limestone on a rather small flat area. The specific epithet relates to the exposed habitat of the species.

*Proposed IUCN category.* The new taxon is found only in the type locality, in a very rare and unusual habitat within Thailand, namely exposed limestone in Sangkhla Buri District, Kanchanaburi Province. The observed expansion of a road next to the type locality may have a negative impact on *Begonia exposita* in the near future. Moreover, the site of the mentioned species is not a protected area. Hence, we consider *Begonia exposita* to be Vulnerable under the VUD2 criterion.

***Begonia pengchingii* Phutthai & M.Hughes sp. nov.** Sect. *Diploclinium*. **Figs 2, 3.**

A distinct species, closest to *Begonia discreta* in having 1 or 2 elongate-cordate symmetrical or subsymmetrical leaves and inflorescence arising from the tuber. It differs in having 2 tepals in the staminate flowers (not 4), variegated leaves, and one enlarged abaxial wing on the fruit, with the others reduced to small ridges (not 3 subequal wings). The leaf variegation is very similar to that in *Begonia curtisii* Ridl., but that species (in sect. *Parvibegonia* A.DC.) has asymmetrical leaves and 2-locular fruit. – Type: Thailand, Chiang Rai, Mae Sai District. On limestone cliff face in deep shade of summit cliff, 1350 m, 30 x 2005, C.-I Peng, C.-I Huang, J.F. Maxwell & P. Palee 20670 (holo HAST; iso BKF, E).

Perennial monoecious herb, 10–20 cm tall. *Tubers* globose or subglobose, c.10 mm in diam., with numerous fibrous roots. *Stems* succulent, glossy, erect or suberect, with sparse multicellular hairs, dark red. *Leaves* only 1 or 2 per plant, basifixed, arising from the tuber or 1 or 2 cauline leaves present subtending the inflorescence; petiole



FIG. 3. *Begonia pengchengii* Phutthai & M. Hughes. A, Habit and habitat; B, adaxial and abaxial lamina; C, inflorescence; D, mature capsules (all from Peng *et al.* 20670).

dark red, 3.5–7 cm long; leaf blade succulent, subsymmetrical, chartaceous when dry, adaxial surface with sparse multicellular hairs, dark green or brownish–dark green with a silver band running inside the margin, glossy, abaxial surface pale purplish red or vinaceous, with dense multicellular hairs especially on veins, cordate, 6–13 × 3–10 cm, base cordate, apex acute, margin sinuate or remote sinuate with multicellular hairs, venation palmate-pinnate, veins 6–8. *Stipules* not seen. *Inflorescences* arising directly from tuber, polychasium, bisexual, branched 1 or 2 times, 9–13 cm long, with many staminate flowers and 2 pistillate flowers per branch, protandrous; peduncles terete, 3–14 cm long, pale green or dark red, glossy, glabrous. *Bracts* not seen. *Staminate flowers*: pedicels 3–10 mm long, erect; tepals 2, white, ovate, c.7 × 4 mm, base rounded, apex obtuse, margin entire, sparse dark red multicellular glandular hairs on outsides, glabrous inside; androecium zygomorphic, stamens 10–15, yellow, filaments c.1 mm long, anthers obovate, c.1 mm long, dehiscing by longitudinal slits near the tip, filaments fused at the base. *Pistillate flowers* not seen; ovary with 1 wing and 2 small ridges; 3-locular, placentation axillary, 2 branches per locule. *Fruits* dehiscent, glossy, pale green, pendulous, drying pale brown; capsule locules ellipsoid, 15–20 × 5 mm, abaxial wing obliquely triangular tapering at the end of the fruit body, 10–15 mm long, 2 lateral wings reduced to ridges.

*Distribution.* Endemic to Northern Thailand; Chiang Rai Province, Mae Sai District, Huay Krai Subdistrict, in front of Doi Tung Temple.

*Habitat and ecology.* On limestone rock crevices in seasonally dry evergreen forest at an altitude of 1350 m. Flowering May to November; fruiting November to January.

*Notes.* *Begonia pengchingii* has an unusual fruit with only one oblique triangular wing, which is unique in *Begonia* section *Diploclinium*; most other species have three subequal wings. The zygomorphic androecium and staminate flowers with two tepals are also unusual in the section, with only five members of the section having the latter (Doorenbos *et al.*, 1998). The epithet *pengchingii* honours Dr Ching-I Peng, who first collected the species.

*Provisional IUCN category.* VUD2. *Begonia pengchingii* is restricted to karst limestone and known only from the type locality in the environs of the Phra That Doi Tung Temple, which although not a formally protected area should be safe from destruction by mining because of its status as a sacred area. However, shifting cultivation, as sometimes practised by farmers in nearby villages, can drastically alter the microhabitat of karst vegetation, especially in terms of causing reduced shade and humidity (Kiew, 2001; Clements *et al.*, 2006). Karst limestone areas can also attract tourists in large numbers, which can lead to habitat degradation. Therefore, we consider *B. pengchingii* to be vulnerable to human activities and assign the Vulnerable category under criterion D2.

***Begonia phutthaii* M. Hughes sp. nov.** Sect. *Apterobegonia*. Figs 2, 4.

Differs from the allied *Begonia delicatula* in having caducous (not persistent) stipules, a denser indumentum over all vegetative parts (*B. delicatula* has glabrous stems, not densely hairy, and leaves with scattered, not dense hairs). The leaf lamina of *Begonia delicatula* is orbicular-reniform, whereas in *B. phutthaii* it is orbicular-ovate; the lamina margin of *B. phutthaii* is acutely dentate, whereas in *B. delicatula* it is shallowly and broadly crenately lobed and denticulate. The basal lobes of the lamina overlap in *Begonia phutthaii*, and do not overlap in *B. delicatula*. – Type: Thailand, Mae Hong Son, Pang Ma Pha District, Road between Pai and Pang Ma Pha. On vertical limestone in deep shade of dry evergreen forest on limestone, 19°30'8.3"N, 98°16'41.5"E, 632 m, 22 x 2014, D.J. Middleton, C. Hemrat, P. Karaket, C. Puglisi & S. Suddee 5822 (holo E; iso BKF, SING).

Monoecious herb, 10–30 cm tall. *Tubers* globose or subglobose, 5–10 mm in diam., with numerous fibrous roots; *stems* succulent, glossy, erect or suberect, densely pubescent, pale green or pale purple-red. *Leaves* 6–8 per plant, basifixed, alternate; petiole pale green, or pale to dark claret, reddish brown when dry, 5–20 cm long; leaf blade chartaceous, asymmetrical, broadly ovate, 4–13 × 4–14 cm, base cordate, apex acute, margin irregularly dentate, venation palmate, veins 7 or 8, adaxial surface densely pubescent, dull light green or vinaceous-greenish, glossy, abaxial surface densely hairy especially on veins, green or dark vinaceous. *Stipules* persistent, pale green or pale vinaceous, triangular, 4–5 × 2–2.5 mm, apex acute, margin entire, hairy. *Inflorescences* terminal, compound cymes, bisexual, branched 1–4 times, 4–13 cm long, with 4–6 staminate flowers and 2 pistillate flowers per branch, protandrous; peduncles 3–5 cm long, terete, densely pubescent, glossy. *Bracts* caducous, membranous, lanceolate, c. 1–2 × 0.5–2 mm, greenish pink, pale green, glossy, apex acute or obtuse, margin entire, pubescent. *Staminate flowers*: pedicels 5–10 mm long, erect (or ascending); tepals 2 or 4(–5), crimson or pale pink or white; outer 2 orbicular, 4–10 × 5–10 mm, base rounded, apex obtuse or acute, margin entire, glabrous inside, hairy outside; inner 2 oblong, 4–5 × 2 mm, base cuneate, apex obtuse, margin entire, glabrous on both sides; androecium actinomorphic, globose, stamens 40–50, yellow, filaments c. 0.5 mm long, fused to androecium, anthers c. 0.5 mm long, oblong, dehiscent by short slits near the tip. *Pistillate flowers*: pedicels pale crimson, 6–9 mm long; tepals 2–4(–5), same size and colour as the staminate flowers; styles 3, fused at the base, stigmatic band kidney-shaped, surface once spirally twisted, yellow; ovary with 3 equal wings, pink or very pale green, densely pubescent; 3-locular, placentation axillary, 1 branch per locule. *Fruits*: capsules, pinkish white, pendulous, drying pale brown, 5 × 5–6 mm, dehiscent at the end of the wings; locules ovoid, 4–5 × 3–4 mm, 3 equal wings, crescent-shaped.

*Distribution*. Endemic to Northern Thailand; Mae Hong Son and Chiang Rai Provinces.

*Habitat and ecology*. On damp and shaded limestone cliffs in seasonally dry evergreen forest. Flowering May to November; fruiting November to January.



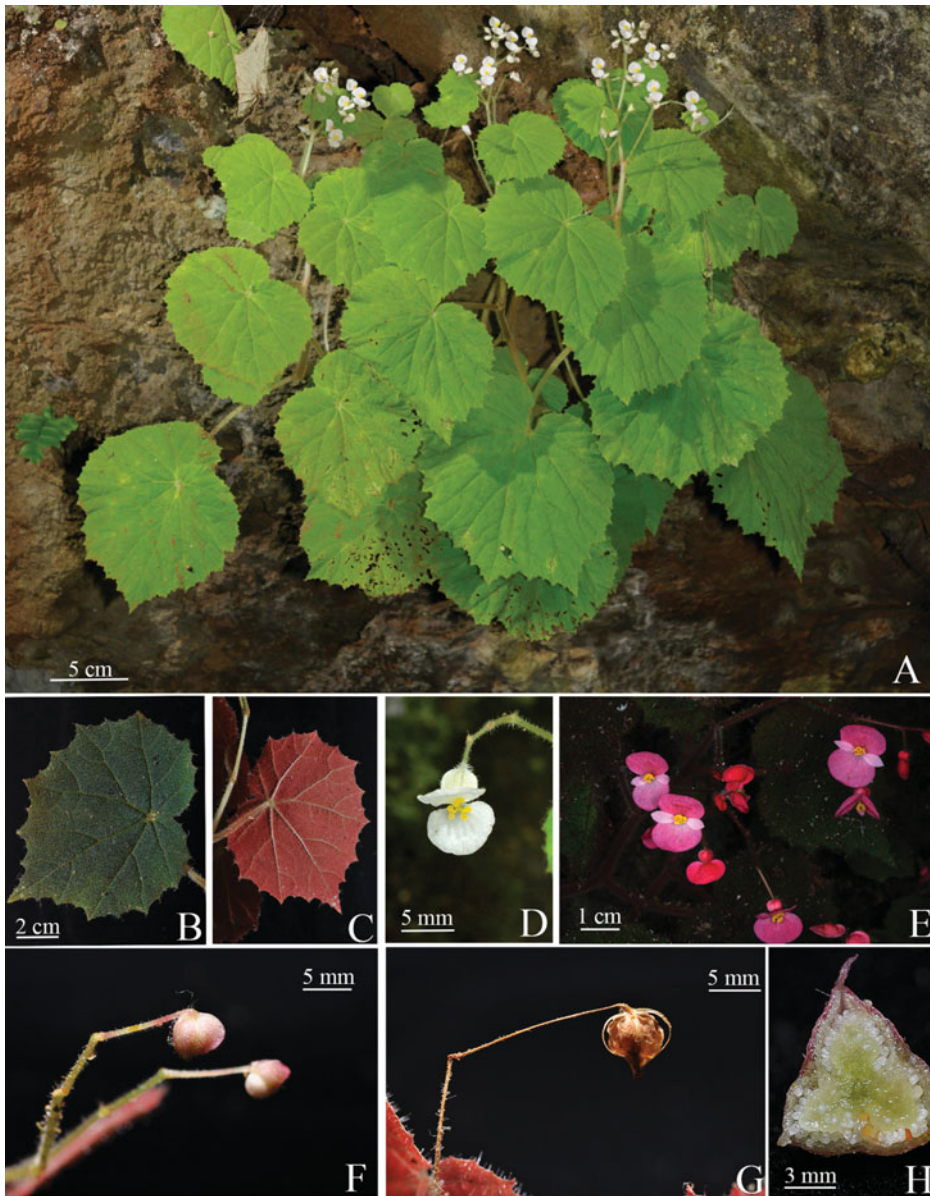


FIG. 4. *Begonia phutthaii* M.Hughes. A, Habit, habitat and inflorescence (Middleton *et al.* 5827); B, adaxial lamina; C, abaxial lamina; D, female flower (Middleton *et al.* 5822); E, male flowers and; F–G, mature capsules; H, ovary, middle cross-section (B, C, E and F–H from Phutthai 263).

*Notes.* The specific epithet *phutthaii* is was coined by the second author of this manuscript, in recognition of the first author's endeavours in the field and herbarium which have done so much to increase our understanding of Thai *Begonia*. The tepal number and shape varies within populations in this species; the type locality has individuals with both 2 and 4 (or 5) tepals in the male and female flowers, with either acute or obtuse apices. Moreover, the leaf colour in different populations in Chiang Rai and Mae Hong Son Provinces varies from pale light green to dark vinaceous according to light, shading and soil composition.

*Proposed IUCN category.* Vulnerable (VUD2). Currently known from only two localities, both karst limestone areas, which are not in National Parks (hills in the Tham Lod Cave area, and cliffs surrounding the Wat Phra That Doi Tung Temple).

*Other material examined. Thailand.* Chiang Rai, Doi Tung, en route from Huai Krai to Wat Doi Tung, c.900 m, 24 ix 1967, *K. Iwatsuki et al.* 10951 (A, AAU, BKF, L); Chiang Rai, Doi Tung, upper catchment valley N of Doi Tung temple, c.1,300 m, 29 x 2005. *C.-I Peng et al.* 20658a & b (HAST); Mae Hong Son, Pang Ma Pha, Tham Lod Cave area, 657 m, 22 x 2014, *D. J. Middleton et al.* 5827 (BKF, E, SING).

***Begonia pseudosubperfoliata* Phutthai & M.Hughes sp. nov.** Sect. *Diploclinium*. **Figs 2, 5.**

Resembles *Begonia subperfoliata* Parish ex Kurz in habit but differs in having 5 tepals in the female flowers (not 2) and glabrous lanceolate bracts (not deeply dissected and papillose). Also similar to *Begonia rabilii* Craib in habit but differs in having 5 tepals in the female flowers (not 4), and leaves with a more deeply crenate margin. – Type: Thailand, Chon Buri, Bo Thong District, Khao Cha Ang On cave. On limestone karst in deep shade, 350 m altitude, 10 ix 2007, *T. Phutthai* 162 (holo BKF; iso E, PSU).

Monoecious herb, 5–15 cm tall. *Stems* tuberous, globose or subglobose, c.10 mm diam., with numerous fibrous roots. *Leaves* 1–(2 or 3) per plant; petiole dark red 2–7 cm long; leaf blade membranous, symmetrical, chartaceous when dry, peltate, petiole insertion 10 mm from the margin, 2–6 × 1–5 cm, base rounded, apex acute, margin crenate or undulate, venation palmate, veins 5 or 6, prominent beneath, adaxial surface dull dark green or bright light green, sparsely echinate, abaxial surface pale green, glabrous on both sides. *Stipules* caducous, lanceolate, c.2 mm long. *Inflorescences* arising from tuber, cymose, bisexual, 5–10 cm long, staminate flowers basal and pistillate flowers distal, protandrous; peduncles terete, dark red or pale green, glabrous, 4–8 cm long. *Bracts* persistent, lanceolate, c.2 × 1 mm. *Staminate flowers*: pedicels glabrous, c.10 mm; tepals 4, pink or pale pink, outer 2 obovate, 5 × 4 mm, base obtuse, apex obtuse, margin entire, glabrous on both sides, inner 2 oblanceolate, 3–4 × 1.5–2 mm, base obtuse, apex obtuse, margin entire, glabrous; androecium zygomorphic, stamens 8–12, filaments nearly free c.0.5 mm long, anthers oblong c.1 mm long, dehiscing by longitudinal slits. *Pistillate flowers*: pedicels 10–15 mm long, pale green, sparsely hairy or nearly glabrous; tepals 4, pink or pinkish white, outer 2 ovate or obovate, c.5 × 4 mm, glabrous, inner 2 oblanceolate, 3 × 1–2 mm, glabrous on both sides; styles



FIG. 5. *Begonia pseudosubperfoliata* Phutthai & M.Hughes. A, Habit and habitat of shaded karst limestone; B, inflorescence; C, male flowers; D, female flower; E, capsule (all photographs from Phutthai 162).

3, fused at base; stigmatic band crescent-shaped; ovary with 3 unequal wings, sparsely pubescent; 3-locular, placentation axillary, 1 branch per locule. *Fruits* dehiscent, drying pale brown, 10–13 × 10 mm including wings; capsule locules globular, c.5 × 4 mm, abaxial wing triangular, 5–8 mm long, 2 lateral wings narrower, narrowly rectangular, 4 mm long and curved along length of capsule.

*Distribution.* Endemic to Southeastern Thailand, Bo Thong District, Chon Buri Province.

*Habitat and ecology.* On karst limestone cliffs in shade, with water seepage at 350 m. Flowering July to September; fruiting September to November.

*Notes.* The specific epithet *pseudosubperfoliata* highlights the similarity of this species to *Begonia subperfoliata*.

*Provisional IUCN category.* Vulnerable VU D2. Endemic to a single locality, the karst cave of Khao Cha-ang. The status of the cave as a tourist attraction means it is less likely to be destroyed by mining, but disturbance through climbing and reduction in the quality of the local microclimate through vegetation clearance have the potential to affect this species adversely.

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