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Two new species and a new record of *Begonia* (Begoniaceae) from Vangvieng karst limestone in central Laos

SOULIVANH LANORSAVANH[1,*], KEOOUDONE SOUVANNAKHOUMMANE[1,2], VICHITH LAMXAY[1] & KHAMFA CHANTHAVONGSA[1]

ABSTRACT

Begonia cataracta and *B. voluptuaria* are described as new species and *B. incerta* is noted as a new record for Laos. Descriptions, illustrations and photographs are provided for the new species and photographs for the new record. Preliminary conservation assessments are made for the two new species which are assessed as Vulnerable and Critically Endangered respectively.

KEYWORDS: Limestone flora, new taxa, new distribution, Cucurbitales, plant taxonomy, waterfall.

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INTRODUCTION

Vangvieng is situated beside the Nam Xong River in Vientiane Province, Lao PDR. Around this small city are multiple limestone karsts that dominate the skyline in a dramatic fashion. This area is famous in Laos for its ecotourism due to its natural caves and beautiful waterfalls and, in the past decade, there have also been many new plant species described from the Vangvieng area (Averyanov & Nguyen, 2012; Averyanov & Tillich, 2015, 2016; Averyanov *et al.*, 2015, 2017, 2019a; Pimenov *et al.*, 2016; Kumar *et al.*, 2017; Lanorsavanh *et al.*, 2020a).

Begonia L. in the Begoniaceae is a large genus with 2,016 accepted species found in tropical to warm temperate regions (Moonlight *et al.*, 2018; Hughes *et al.*, 2015–), with 28 species recorded from Lao PDR (Hughes, 2008; de Wilde *et al.*, 2011; Averyanov & Nguyen, 2012; Souvannakhoummane *et al.*, 2016, 2018, 2020; Yang *et al.*, 2018; Hughes *et al.*, 2018; Averyanov *et al.*, 2019b; Lanorsavanh *et al.*, 2020b; Ding *et al.*, 2020). During botanical surveys in Vangvieng District, Vientiane Province, in central Lao PDR, two new species of *Begonia* section *Platycentrum* A.DC. were found and are described below, along with a new record for the Flora of Laos, *Begonia incerta* Craib in *Begonia* section *Diploclinium* (Lindl.) A.DC.

MATERIAL AND METHODS

Morphological character assessments and measurements of the new species are based on living and dry specimens. The morphological comparisons are based on specimens at the herbaria FOF and HNL, as well as on types online at BM, E, K, NY, P and QBG. Additionally, literature on *Begonia* taxonomy in the region was consulted (Averyanov & Nguyen, 2012; Averyanov *et al.*, 2019b; Gu *et al.*, 2007; Ding *et al.*, 2020; de Wilde *et al.*, 2011; Maw *et al.*, 2020; Moonlight *et al.*, 2018; Hughes, 2008; Hughes *et al.*, 2015–, 2018, 2019; Lanorsavanh *et al.*, 2020b; Peng *et al.*, 2015; Phutthai *et al.*, 2019; Souvannakhoummane *et al.*, 2016, 2018, 2020; Yang *et al.*, 2018;). IUCN Red List Categories and Criteria (IUCN, 2019) were used for the preliminary conservation assessments.

[1] Department of Biology, Faculty of Natural Science, National University of Laos, Vientiane, Laos.

[2] Centre for Development and Environment, Lao Country Office, Ban Phapo, Vientiane, Laos.

* Corresponding author: biokklano@yahoo.com

TAXONOMIC TREATMENT

NEW SPECIES

Begonia cataracta Souvann., Lanors. & Lamxay, **sp. nov.** (Section *Platycentrum*).

Similar to *Begonia rheophytica* M.Hughes, but differs in having elliptic to elliptic-lanceolate leaves (vs narrowly lanceolate); lamina base obtuse (vs attenuate, sometimes unequal); 1–2-flowers per inflorescence (vs more than 5); and peduncles 6–11 cm long (vs 14–20 cm long). It is also similar to *Begonia caobangensis* C.I Peng & C.W.Lin but differs in having lamina base obtuse (vs attenuate); petioles terete, pilose (vs D-shaped, tomentose to glabrous); linear, ca 4 mm long (vs bracts ovate, ca 18 mm long); inflorescences 1- or 2-flowered (vs more than 5); and tepals of pistillate flowers 5, outer 4, inner 1 (vs tepals of pistillate flowers 6, outer 3, inner 3) (Table 1). Type: Laos, Vientiane Province, Vangvieng District, Nadouang Village, Kaeng Nyui Waterfall, 398 m in elevation, 28 Mar. 2021, *Lanorsavanh & Lamxay SL2178* (holotype **HNL!**; isotypes **FOF**, **KKU**). Figs. 1 & 2.

Monoecious rhizomatous herb, 10–20 cm tall. *Rhizomes* elongate, stout, 2–6.5 × 0.5–0.8 cm, reddish-brown with many fibrous roots, pilose. *Leaves* alternate, lamina succulent when fresh, membranous when dry, elliptic to elliptic-lanceolate, 7–11.2 × 2.5–4.5 cm, base obtuse, apex acuminate, margin entire to minutely serrate; adaxial surface green to pale green-yellowish, glabrous; abaxial surface light green-yellowish, densely pilose on veins; 6–7 pairs of veins, reddish, prominent beneath. *Petioles* terete, 4.5–14 cm long, reddish, fleshy, pilose. *Stipules* triangular-ovate, 3–8 × 3–5 mm, apex acute, pilose on outer surface, reddish. *Inflorescences* axillary, arising from rhizome, 1–2-flowered. *Bracts* 2, linear, ca 4 × 3 mm, reddish, puberulent. *Peduncles* 6–11.7 cm long, reddish, terete, pilose. *Staminate flowers*: pedicels 1–2 cm long,

Table 1. Comparison of characters *Begonia catarcacta*, *B. rheophytica* and *B. caobangensis.*

Characters	***B. cataracta***	***B. rheophytica*** [2,3]	***B. caobangensis*** [1]
Leaves	elliptic, elliptic-lanceolate; 7–11.2 cm long	narrowly lanceolate; 13.4–18.2 cm long	narrowly elliptic to elliptic or slightly rhomboid, 11–21.5 cm long
Petiole	terete, pilose	terete, pilose	D-shaped, tomentose to glabrous
Lamina base	obtuse	attenuate, sometime unequal	attenuate
Stipules	triangular-ovate, 3–8 mm long	narrowly triangular, 7–10 mm long	ovate, 20–25 mm long
Bracts	linear, ca 4 mm long, reddish	broadly ovate-triangular, 6–8 mm long, dark yellow-green	ovate, ca 18 mm long, crimson
Inflorescences	1 or 2-flowered	More than 5-flowered	More than 5-flowered
Peduncles	6–11.7 cm long	14–20 cm long	8–12 cm long
Staminate flowers	inner tepal pair linear-oblong, narrowly obovate, 0.4–0.7 cm wide, anthers obovate	inner tepal pair elliptic, 0.8–1 cm wide, anthers narrowly oblong	inner tepal pair obovate, 0.6–0.8 cm wide, anthers lanceolate to oblanceolate
Pistillate flowers	pedicels 1–1.3 cm long, tepals 5, outer 4 unequal, broadly elliptic, obovate; inner 1 smaller, oblanceolate	pedicels 2–3 cm long, tepals 5–6, outer 2 unequal, broadly ovate; inner 3 or 4, elliptic	pedicels 1.2–1.8 cm long, tepals 6, outer 3 unequal, obovate to elliptic; inner 3, obovate to narrowly elliptic
Styles	connate at the base, dark yellow	free, green, yellow	connate at base, yellow
Stigmas	spirally branched and minutely papillose	bifid with twisted bands, papillose	undulate and spirally twisted, papillose
Ovary	reddish-greenish	purplish red	reddish

[1]Peng *et al.*, 2015; [2]Hughes *et al.*, 2019; [3]Maw *et al.*, 2020.

straight, light green, pilose; tepals 4, white-pink, outer pair broadly ovate, 1.3–1.7 × 1–1.5 cm, apex rounded or acute, red strigose on outer surface, inner pair linear-oblong to narrowly obovate, 1–1.8 × 0.4–0.7 cm, apex rounded, glabrous; stamens ca 118, bright yellow; filaments united at base, 0.5–1 mm long; anthers obovate, 0.8–1.2 mm long, dehiscing by longitudinal slits near the apex, apex rounded. *Pistillate flowers*: pedicels 1–1.3 cm long, green-reddish, pilose; tepals 5, white-pink, 4 outer unequal, broadly elliptic, obovate, 12–14 × 5–12 mm, apex rounded, sparsely strigose on outer surface, inner 1 smaller, oblanceolate, 8–10 × 2.5–3 mm, apex rounded, glabrous; ovary green-reddish, sparely red strigose, with 3 unequal wings, dorsal wing broadly falcate, lateral wing triangular, apex obtuse, 2-locular, placentation axillary, two branches per locule; styles 2, connate at the middle, dark yellow, stigma spirally branched and minutely papillose. *Fruits* reddish-greenish, drying brown, ovoid, 2.3–2.5 × ca 1 cm (including wings), strigose. *Seeds* numerous, ellipsoid, ca 0.5 × 0.4 mm, reticulate, brownish yellow.

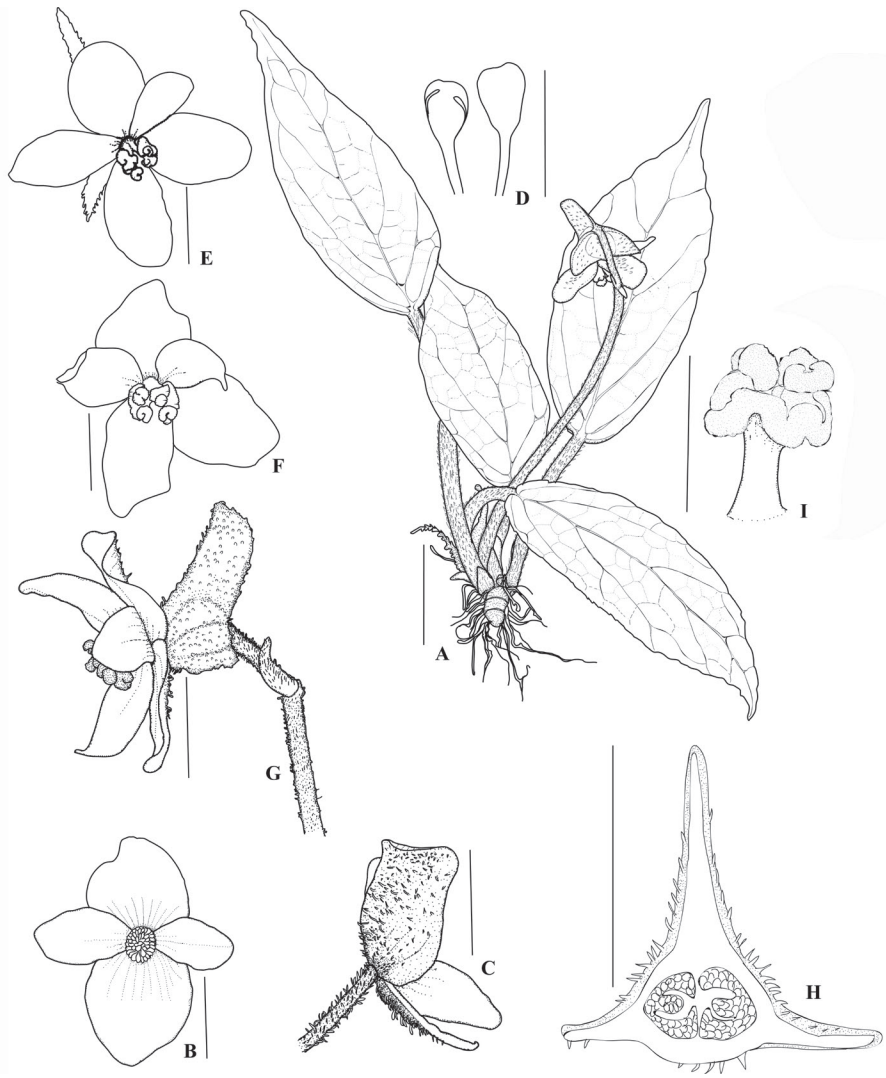

Figure 1. *Begonia cataracta* Souvann., Lanors. & Lamxay: A. habit; B. male flower front view; C. male flower back view; D. anthers; E-F. female flower front view; G. female flower side view; H. cross section of ovary; I. stigma. Scale bars: A, 2 cm; B, C, E, F, G, H, 1 cm; D, 2 mm; I, 5 mm. Drawn by K. Souvannakhoummane from *Lanorsavanh & Lamxay SL2178*.

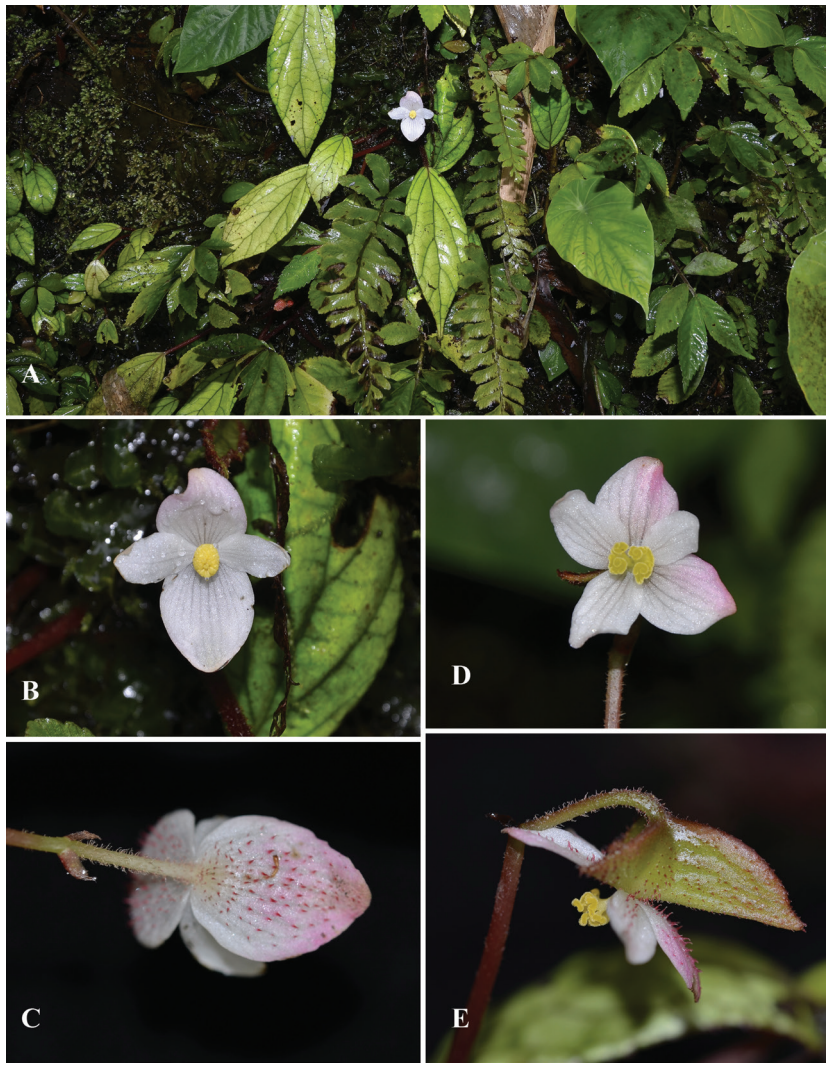

Figure 2. *Begonia cataracta* Souvann., Lanors. & Lamxay: A. habit; B. male flowers front view; C. male flower back view; D. female flower front view; E. female flower side view. All from *Lanorsavanh & Lamxay SL2178* (type material). Photographs: S. Lanorsavanh.

Distribution and habitat.— Known only from the type locality in Kaeng Nyui Waterfall, Nadouang Village, Vangvieng District, Vientiane Province. It is found on wet limestone rocks in mixed deciduous forest ca 400 m altitude.

Phenology.— Flowering in March–April and fruiting in March–May.

Etymology.— The specific epithet '*cataracta*' (Latin, waterfall) refers to the waterfall habitat of the species.

Vernacular.— ລື້ມກ້ຳແກ້ງຫຍຸຍ (Som koung kaeng nyui [Kaeng Nyui's *Begonia*]).

Preliminary conservation assessment.— *Begonia cataracta* is only known from the type locality which is outside a protected area, but in an area that is of high priority for conservation of the natural habitat for eco-tourism purposes. It has a small area of occupancy (AOO) of only 4 km^2 but the habitat around the waterfall is currently in good condition. The waterfall, however, is a popular tourist destination and the site should be monitored to see what affect if any this has on the quality of the habitat. As the population is estimated to be about 500 individual plants, we assess the species as Vulnerable (VU D1).

Begonia voluptuaria Lanors., Souvann. & Lamxay, **sp. nov.** (Section *Platycentrum*).

Similar to *Begonia dryadis* Irmsch., but differs in having rhizomes globose (vs elongate); stems pilose (vs puberulous); stamens ca 50 (vs 100–160); outer pair of tepals of pistillate flowers lanceolate, strigose (vs broadly ovate, puberulous); and dorsal wing of ovary broadly falcate-linear, densely strigose, apex acute (vs dorsal wing oblong, puberulous, apex rounded). It is also similar to *Begonia augustinei* Hemsl. but differs in having leaves lanceolate (vs ovate to broadly ovate); bracts lanceolate (vs oblong); and outer tepals of pistillate flowers lanceolate, strigose, inner tepals narrowly lanceolate (vs oblong to ovate, pilose, inner elliptic) (Table 2). Type: Laos, Vientiane Province, Vangvieng District, Nasom Village, Pha Hone Kham Hill, 835 m in elevation, 16 Sep. 2020, *Lanorsavanh, Lamxay & Xaiyavong SL1990* (holotype **HNL!**, isotypes **FOF**, **KKU**). Figs. 3 & 4.

Monoecious rhizomatous herb, 10–30 cm tall. *Rhizomes* globose, stout, 0.5–2.5 × 0.7–1.5 cm, reddish-brown with many fibrous roots. *Stems* erect to ascending, 2–19 cm long, 2.5–4.5 mm thick, reddish, succulent, pilose. *Leaves* 2–8 per stem, alternate, lamina succulent when fresh, membranous when dry, asymmetric, oblique lanceolate, 4.5–20 × 2.8–13.8 cm, base oblique cordate, apex acuminate, margin serrate to entire; adaxial surface dark green or sparsely white spotted, sparsely scabrid; abaxial surface light green, scabrid and densely pilose on veins; venation palmate, veins 6–7, prominent beneath. *Petioles* terete, 1.7–16 cm long, reddish, fleshy, pilose. *Stipules* triangular-linear, 7–11 × 1–3 mm, margin strigose, apex acuminate, outer surface pilose, light green. *Inflorescences* compound cymes, arising from axils near apex of stem, branched 1–3 times, bisexual, 7–24 cm long, staminate flowers distal and pistillate flowers basal, protandrous. *Peduncles* 5–16 cm long, reddish, terete, pilose. *Bracts* lanceolate, 5–6 × 1–2 mm, apex acute, margin strigose, pilose on outer surface, pale green. *Staminate flowers*: pedicels 7–12 mm long, straight, recurved near apex, reddish, pilose; tepals 4, pink-white, outer pair lanceolate, 12–14 × 4–6 mm, apex acuminate, red strigose on outer surface, inner pair linear-oblong, 7–9 × 2–2.5 mm, apex acuminate, glabrous; stamens ca 50, bright yellow; filaments

Table 2. Comparison of characters *Begonia voluptuaria*, *B. dryadis* and *B. augustinei.*

Characters	***Begonia voluptuaria***	***B. dryadis*** [1,2]	***B. augustinei*** [1]
Stems	erect to ascending, pilose	erect, puberulous	absent
Leaves	oblique lanceolate, scabrid and pilose	ovate or broadly ovate, puberulous	ovate to broadly ovate, hirsute
Petioles	1.7–16 cm long, pilose	18–42 cm long, puberulous	15–22 cm long, villous
Stipules	triangular-linear, 7–11 mm long	triangular-ovate, 13–15 mm long	ovate, 7–8 mm long
Bracts	lanceolate, 5–6 × 1–2 mm, apex acute, pilose	rhomboid-ovate, 1.5–1.9 × 4–18 mm, puberulous	oblong, ca 10 × 4 mm, puberulous
Staminate flowers	outer tepal pair lanceolate, 4–6 mm wide, strigose, inner pair linear-oblong, 2–2.5 mm wide, stamens ca 50	outer tepal pair narrowly ovate, 8–20 mm wide, puberulous, inner pair oblong, 5–15 mm wide, stamens 100–160	outer tepal pair oblong to ovate, ca 9 mm wide, pilose, inner pair elliptic, ca 7 mm wide, stamens ca 60
Pistillate flowers	outer tepal pair unequal, lanceolate, 6–8 mm wide, strigose; inner narrowly lanceolate, 2–3 mm wide, glabrous	outer tepal broadly ovate, 11–13 mm wide, puberulous; inner elliptic, 7–13 mm wide, puberulous	outer tepal pair unequal, elliptic-oblong, 6–12 mm wide, strigose; inner narrowly elliptic-oblong, 5–10 mm wide, glabrous
Ovary	densely red strigose, dorsal wing broadly falcate-linear, apex acute	puberulous, dorsal wing oblong, apex rounded	pilose, dorsal wing broadly falcate, apex rounded

[1]Gu *et al.*, 2007; [2]Ding *et al.*, 2020.

free, fasciculate, 1.7–2.4 mm long; anthers oblong, 1.2–1.5 mm long, dehiscing by longitudinal slits near the apex, apex rounded. *Pistillate flowers*: pedicels 14–18 mm long, dark red, villous, scabrid on surface; tepals 5, pink, outer 2 unequal, lanceolate, 10–14 × 6–8 mm, apex acuminate, sparsely strigose on outer surface, inner 3 smaller, narrowly lanceolate, 8–9 × 2–3 mm, apex acuminate, glabrous; ovary green, light green, densely red strigose, with 3 unequal wings; dorsal wing broadly falcate-linear, lateral wings triangular, apex acute, 2-locular, placentation axillary, two branches per locule; styles 2, connate at the base, dark yellow, stigma spiral and minutely papillose. *Fruits* green, drying brown, ovoid, 9–11 × 18–22 mm (including wings), strigose. *Seeds* numerous, globose, ca 0.5 × 0.4 mm, reticulate, brownish-yellow.

Distribution and habitat.— Known only from the type locality in Vangvieng District, Vientiane Province. It grows in sandy soil on limestone rocks in mixed evergreen forest ca 850 m altitude.

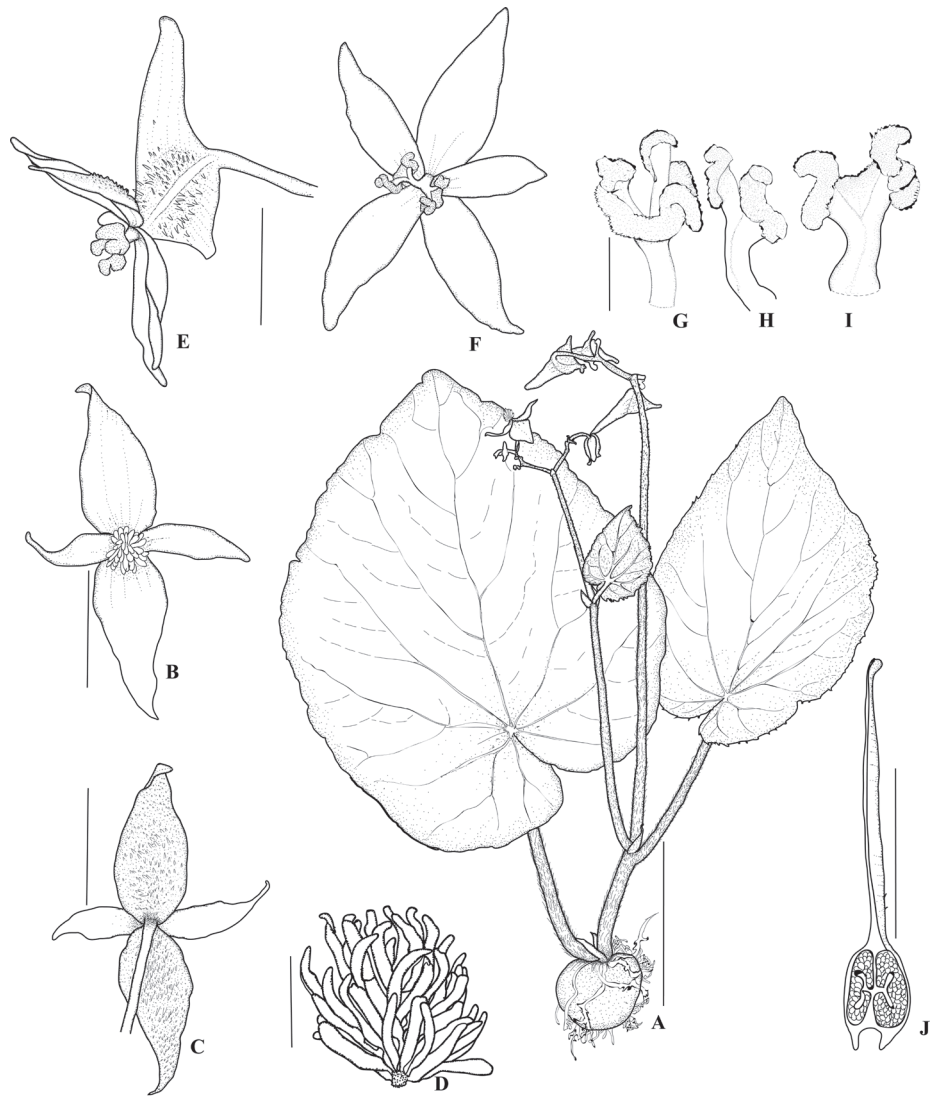

Figure 3. *Begonia voluptuaria* Lanors., Souvann. & Lamxay: A. habit; B. male flower front view; C. male flower back view; D. androecium; E. female flower side view; F. female flower front view. G–I. stigma. J. cross section of fruit. Scale bars: A, 5 cm; B, C, E, F, J, 1 cm; D, G, H, I, 2 mm. Drawn by K. Souvannakhoummane from *Lanorsavanh et al. SL1990*.

Phenology.— Flowering in September and fruiting in September–October.

Etymology.— The specific epithet '*voluptuaria*' (Latin, tourism) refers to the popularity with tourists of the area in Vangvieng district where the species grows.

Vernacular.— ສົ້ມກຸ້ງວຽງວັ ງ (Som koung vangvieng [Vangvieng's *Begonia*]).

Preliminary conservation assessment.— *Begonia voluptuaria* is only known from the type locality which is outside a protected area, but in an area that is of high priority for conservation of the natural habitat for eco-tourism purposes. This particular limestone site is popular for trekking. It has a small area of occupancy (AOO) of only 4 km^2 but this limestone site has not been damaged at present. The population is estimated at more than 100 individual

Figure 4. *Begonia voluptuaria* Lanors., Souvann. & Lamxay: A. habit; B. male flowers front view; C. male flower side view; D. female flower front view; E. female flower side view. All from *Lanorsavanh et al. SL1990* (type material). Photographs: S. Lanorsavanh.

plants but as they are particularly attractive to the tourists and are sometimes removed from the site, there is a concern that the population could reduce over time. We therefore consider a category of Critically Endangered CR B2ab(v) is appropriate.

NEW RECORD

Begonia incerta Craib, Bull. Misc. Inform. Kew 1911: 57. 1911; Gagnep. in Lecomte, Fl. Indo-Chine 2: 1116. 1921; Craib, Fl. Siam. 1: 774. 1931; Hughes, Annot. Checkl. SE Asian *Begonia*. 54. 2008. Phutthai *et al.* in Chayamarit & Balslev, Fl. Thailand 14: 388. 2019. Type: Thailand, Meh Ping Rapids, 180 m alt., 15 Dec. 1908, *Kerr 508* (holotype **K** [K000761182]; isotype **BM**).

— *Begonia kerrii* Craib, Bull. Misc. Inform. Kew 1911: 57. 1911; Gagnep. in Lecomte, Fl. Indo-Chine 2: 1118. 1921; Craib, Fl. Siam. 1: 775. 1931: Hughes, Annot. Checkl. SE Asian *Begonia*. 64. 2008; Phutthai *et al.* in Chayamarit & Balslev, Fl. Thailand 14: 388. 2019. Type: Thailand, Ban Kan, *Kerr 508A* (holotype **K** [K000761179]; isotype **BM**).

— *B. intermixta* Irmsch., Mitt. Inst. Allg. Bot. Hamburg 8: 101. 1929; Hughes, Annot. Checkl. SE Asian *Begonia*. 57. 2088; Phutthai *et al.* in Chayamarit & Balslev, Fl. Thailand 14: 388. 2019. Type: Thailand, Kasum, Nov. 1896, *Curtis s.n.* (syntype **K** [K000761196]). Fig. 5.

Distribution and habitat.— This species was described from Thailand by Craib (1911) and later also reported from Myanmar (Phutthai *et al.*, 2019).

Figure 5. *Begonia incerta* Craib: A. habit; B. inflorescence with side view of flowers; C. inflorescence with front view of flowers. All from *Lanorsavanh et al. SL1992*. Photographs: S. Lanorsavanh.

In Laos, it has been found in deciduous forest ca 800 m in the Vangvieng limestone karst area.

Phenology.— Flowering in September–October and fruiting in November–December.

Vernacular.— ສົ້ມກຸ້ງມະລິ (Som koung mali [Jasmine's *Begonia*]).

Specimens examined.— LAOS, Vientiane Province, Vangvieng District, 20°26'16.0"N 104°11'47.0"E, 825 m alt., 16 Sept. 2020, *Lanorsavanh et al. SL1992* (**HNL**, **FOF**, **NLS**).

Notes.— *Begonia incerta* Craib is similar to *B. kanburiensis* Phutthai & M.Hughes, in usually having single leaves arising from a tuber, but differs in having uniform green leaves, while *B. kanburiensis* has brown leaves with silver spots.

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