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AN UPDATED CHECKLIST AND A NEW SPECIES OF *BEGONIA* (*B. RHEOPHYTICA*) FROM MYANMAR

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A new species, *Begonia rheophytica* (§ *Platycentrum*), is described from northern Myanmar; it was initially confused with *B. rhoephila*, which is confined to Peninsular Malaysia. Comparison with other species with a rheophytic leaf shape is made. This new addition brings the number of currently recognised *Begonia* species in Myanmar to 73. An updated checklist of Myanmar *Begonia* species is also included.

Keywords. Biodiversity, Hkakaborazi National Park, Kachin State, Myanmar, taxonomy.

Introduction

Myanmar is the largest country in continental Southeast Asia, spanning c.20 degrees of latitude and encompassing 14 terrestrial ecoregions (Olson *et al.*, 2001), resulting in a great diversity of habitats and an equally rich flora. Although new species continue to be documented, particularly from northern Kachin State (e.g. Yang *et al.*, 2017; Ding *et al.*, 2018; Tan *et al.*, 2018), the flora is still relatively poorly known (Hundley & Chit Ko Ko, 1961; Frodin, 2001). This research is part of an ongoing collaboration between the New York Botanical Garden, the Royal Botanic Garden Edinburgh and the Myanmar Forest Research Institute to document the flora of northern Myanmar.

During a 2001 expedition by the third author, a new lanceolate-leaved *Begonia* species was noticed (but not collected) growing in a seasonal stream bed between Sinlumdan and Nam Ti, on the Babulongtan mountain trail (at c.27.41°N, 97.62°E). Five subsequent expeditions were made to the region, but this species was not found again until it was collected in approximately the same locality during a June 2017 expedition to the buffer zone of Hkakaborazi National Park (*Armstrong* 3041 [E, K, NY]). This specimen matched six previous collections from the same area (*Toppin* 4264 [K]; *Kingdon-Ward* 5561 [E], 6633 [K], 7355 [K], 9067 [BM(2), NY], 13567 [BM]), some of which were listed as doubtful records of *Begonia rhoephila* Ridl. from Myanmar in Hughes (2008), where it is stated, "There are no records of *B. rhoephila* between northern Myanmar and Selangor in Peninsular Malaysia, to which Kiew (2005) records it as endemic. Whilst there is a gross similarity of the Burmese specimens to *B. rhoephila*, they differ in having longer petioles,

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longer internodes, the occasional appearance of caulescent stems and the presence of curled, fleshy hairs on the veins on the underside of the leaves".

Since the first checklist for Myanmar listed 57 species of *Begonia* (Hughes, 2008), several new species and records have been published: *B. difformis* (Irmsch.) W.C.Leong, C.-I Peng & K.-F.Chung (Leong *et al.*, 2015), *B. discreta* Craib (Kang *et al.*, 2018), *B. foveolata* Irmsch. (omitted from Hughes, 2008, in error, as the type is from Yangon ['Rangoon']) (Irmscher, 1959), *B. hayamiana* Nob. Tanaka (Tanaka & Hughes, 2007), *B. hymenophylla* Gagnep. (Hughes *et al.*, 2015–), *B. kachinensis* Nob. Tanaka (Tanaka & Hayami, 2011), *B. lushaiensis* C.E.C.Fisch. (reinstated from synonymy with *B. modestiflora* Kurz by Camfield & Hughes, 2018), *B. macrotoma* Irmsch. (Hughes *et al.*, 2015–), *B. mariachristinae* Wahlsteen (Wahlsteen, 2018), *B. minicarpa* H.Hara (Hughes *et al.*, 2015–), *B. myanmarica* C.-I Peng & Y.D.Kim (Tseng *et al.*, 2017), *B. siamensis* Gagnep., *B. soluta* Craib (Kang *et al.*, 2018), *B. tenasserimensis* Phutthai & M.Hughes (Phutthai & Hughes, 2017), *B. togashii* Nob. Tanaka & C.-I Peng (Tanaka & Peng, 2016) and *B. wui-senioris* C.-I Peng (a valid name for the taxon *B. lacei* ined. (Peng *et al.*, 2014). The record for *Begonia oreodoxa* Chun & F.Chun ex C.Y.Wu & T.C.Ku from Myanmar in Hughes (2008) is probably an error, and we also consider the record of *B. incerta* Craib in Kang *et al.* (2018) to be a misidentification (T. Phutthai, Mahidol University, personal communication). The specimens listed above do not match any of the species currently known from Myanmar, and they also differ from *Begonia rhoephila* from Malaysia; given the remarkable dispersal limitation and narrow endemism of most *Begonia* species (Hughes & Hollingsworth, 2008), the occurrence of this tropical species in the mountains of northern Myanmar is very unlikely.

Here we describe the new species *Begonia rheophytica*, bringing the total number of *Begonia* species known from Myanmar to 73 (listed in the Appendix). The new species belongs in *Begonia* sect. *Platycentrum* (Klotzsch) A.DC., as it has fruit with one enlarged wing, and anthers with extended connectives (Doorenbos *et al.*, 1998; Moonlight *et al.*, 2018). We compare our specimens with two other species in *Begonia* sect. *Platycentrum*, namely *B. caobangensis* C.-I Peng & C.W.Lin from Vietnam (Peng *et al.*, 2015) and *B. yingjiangensis* S.H.Huang from Yunnan, China (Shui & Huang, 1999), which have a similar leaf shape and a closer geographical range.

Taxonomic treatment

Begonia rheophytica M.Hughes, **sp. nov.** § *Platycentrum*. – Type: Myanmar. Hills east of the Mali Hka, 2000–3000 ft, xii 1930, *Kingdon-Ward* 9067 (holo BM [BM000896328]; iso BM [BM000896327], NY [02652766]). **Figs 1, 2**.

Differs from *Begonia caobangensis* C.-I Peng & C.W.Lin in having narrower leaves (2–2.5 cm wide, not 3.9–7.3 cm) without winged petioles (versus petioles slightly winged), with the petioles having longer erect hairs (not minutely appressed tomentose to glabrous), and fruits without fleshy bristles at the apex of the wings.

Differs from *Begonia rhoephila* Ridl. in having shorter, curled hairs on the petioles (not erect, straight hairs), having glabrous bracts and stipules (not bracts with short hairs

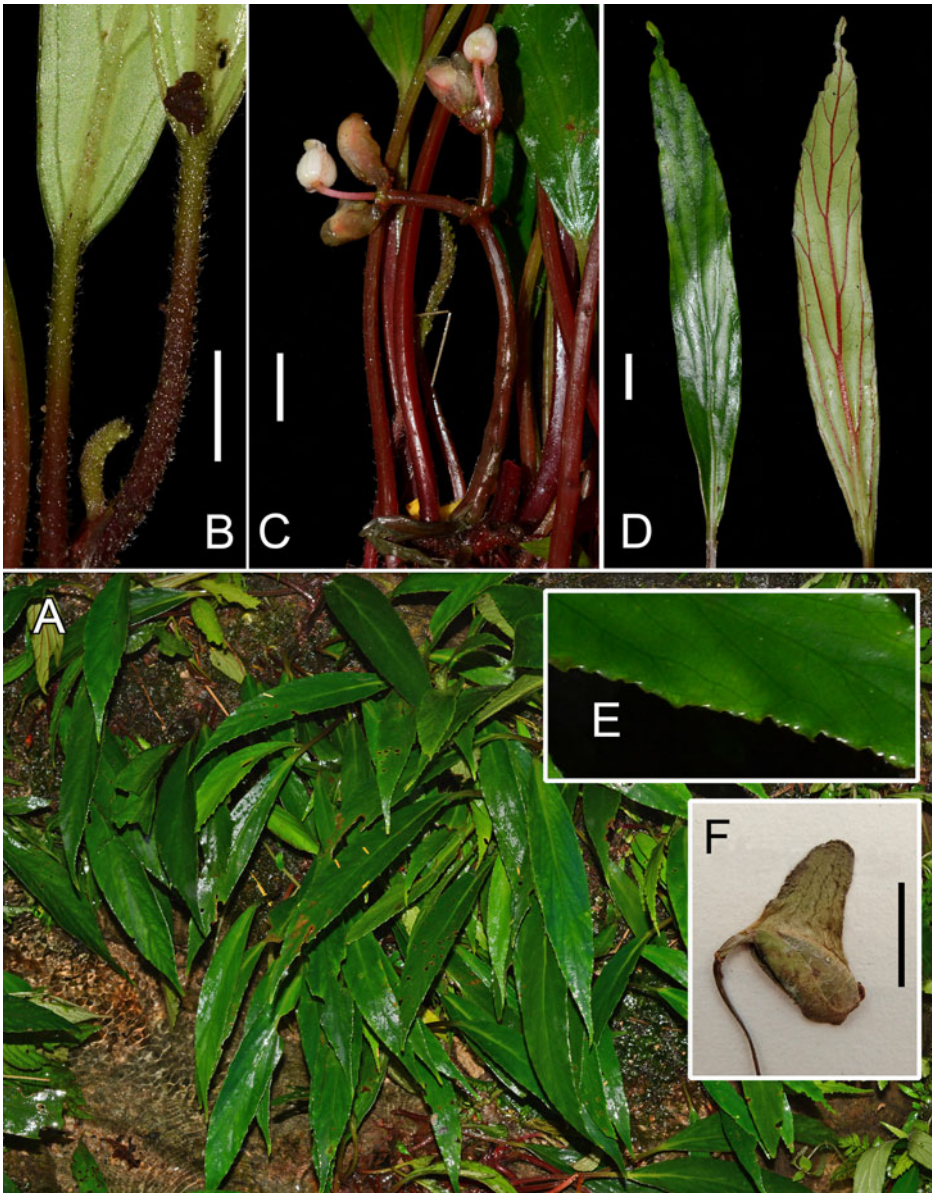

FIG. 1. *Begonia rheophytica* M.Hughes, sp. nov. A, Habit in the field (note water level at the base of the image); B, abaxial surface of petiole, showing short curled hairs; C, inflorescence; D, adaxial (left) and abaxial (right) leaf surface; E, lamina margin; F, unripe fruit. A–E, *Armstrong* et al. 3041; F, *Kingdon-Ward* 13567. All scale bars, 1 cm.

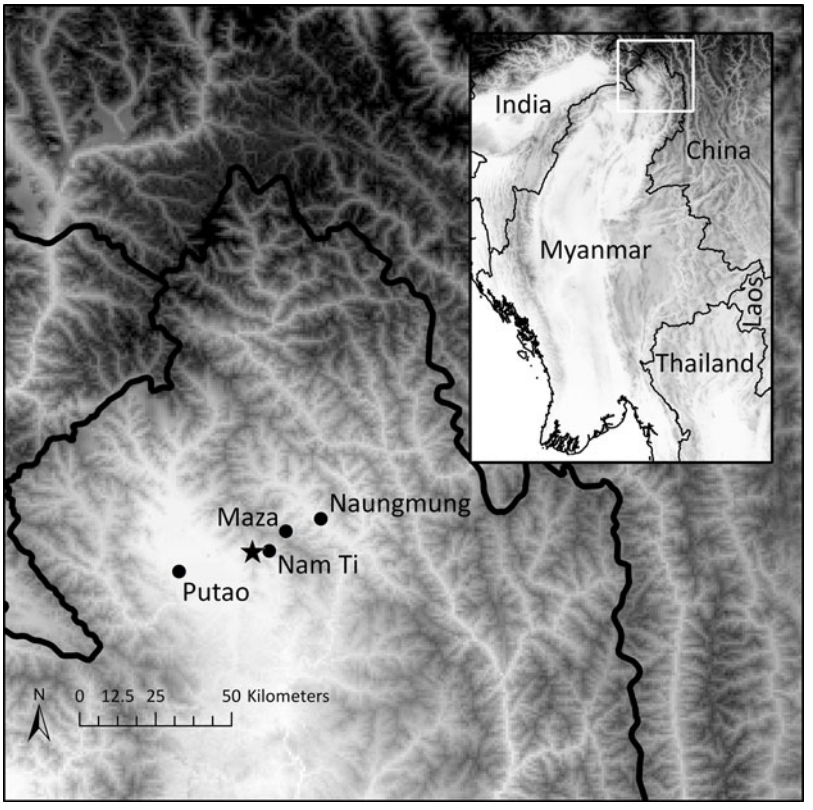

FIG. 2. Distribution of *Begonia rheophytica* M.Hughes (star) in northern Myanmar, with adjacent towns highlighted for reference (circles).

and stipules with hairs along the keel), and sometimes cauline leaves subtending the inflorescence (not inflorescence always arising directly from the rhizome).

Differs from *Begonia yingjiangensis* S.H.Huang in having smaller leaves (9–13 × 2–2.5 cm, not 22–29.5 × 5–7.5 cm), with a broadly denticulate margin (not subentire and slightly repand).

Rheophytic herb. *Stem* rhizomatous, c.5 mm wide when dry, internodes usually 2–5 mm long, sometimes extending to c.7 cm long on the apical flowering portion of the plant. *Stipules* 15 × 5 mm, glabrous, keeled, triangular, cuspidate, tip extending 2 mm. *Leaves*: petiole 4.5–10 cm long, slightly grooved or flattened adaxially, giving a D-shaped cross-section, c.1.5 mm wide when dry, with sparse to dense short, thin curly hairs on the abaxial side of the petiole, the adaxial side being glabrous; lamina coriaceous (‘rather thick and leathery’, *Ward* 5561), 9–13 × 2–2.5 cm, elongate lanceolate, symmetrical, base cuneate, tip acute, glabrous above, with short, thin curly hairs on the main veins only beneath, venation pinnate with c.8 pairs of alternate veins, margin broadly denticulate. *Inflorescence* axillary, cymose, usually arising from the rhizome, sometimes arising from the axil of an

elongated apical portion of the stem and possessing cauline leaves, primary peduncle (5–) 10–14 cm long, secondary up to 5 cm long, with up to c.7 flowers; bracts glabrous: first pair subtending the first branching of the inflorescence fused together forming a cup c.10 mm long, subsequent bracts not fused, ovate-lanceolate, c.6 mm long, smaller towards the terminal dichotomy. *Male flowers*: pedicel c.10 mm long, glabrous; tepals 4, glabrous, white or white suffused with pink, outer pair c.15 × 9 mm, inner pair c.12 × 5 mm; androecium with c.100 stamens on a short column, filaments c.1.5 mm long, anther c.1.5 mm long, oblong, connective extended, rounded in basal anthers and acute in apical anthers, slits lateral, extending most of the length of the anther. *Female flowers* unknown. *Fruit* borne in pairs, 2-locular, recurved, glabrous, upper wings rectangular, c.5 × 9 mm, forming a splash cup, lower wing rounded triangular, c.11 × 8 mm.

Additional specimens examined. MYANMAR. **Kachin State**: Putao District, Machanbaw Township, buffer zone of Hkakaborazi National Park, along trail between Nam Ti and Sinlundam, 798 m, 20 vi 2017, *Armstrong* 3041 with *Thet Yu Nwe, Moe Myint Thu, San Naing Dee, Zaw Naing Tun, Hla Naing Htay, Pa Rang Gang Ken Sar* (E, NY [02654022], RAF); Kachin Hills, *Toppin* 4264 (K); Nam Ti, 16 xi 1922, *Kingdon-Ward* 5561 (E [00300496]); Nam Ti, 2000 ft, 18 iv 1926, *Kingdon-Ward* 6633 (K); Mountains E of Fort Hertz, 3000 ft, 9 ix 1926, *Kingdon-Ward* 7355 (K); Hills east of Putao, 3000 ft, 10 xii 1937, *Kingdon-Ward* 13567 (BM).

Distribution and ecology. Forms large colonies on boulders in streams, a narrow endemic to Nam Ti in the north of Kachin State, Myanmar, at c.600–1200 m elevation (Fig. 2). Kingdon-Ward noted (*Kingdon-Ward* 7355 [K]) that the plant is 'found on wet moss covered rocks in jungle torrents. The plant is liable to be more or less submerged during the summer rise'; 'In massive clumps on stones in perennial streams, now uncovered, but submerged in the rainy season. Only seen in two streams where is was fairly abundant' (*Kingdon-Ward* 9067 [BM]).

Etymology. Named after the rheophytic habit of the species (*rheo-*, pertaining to flowing water [Greek]).

Proposed IUCN conservation status. The only known locality is currently outside the core of the Hkakaborazi National Park. The area is potentially vulnerable to encroachment in the next decade or so, as slash-and-burn agriculture moves further up the mountain. Therefore, we consider a placement in the Vulnerable category under VU D2 (IUCN, 2017) to be appropriate, although a successful outcome for the proposed UNESCO World Heritage Site status for the area would improve the outlook for the species and necessitate a reconsideration of this category.

DISCUSSION

The initial confusion of *Begonia rheophytica* with *B. rhoephila* and the similarity of the new species to the geographically close *B. caobangensis* and *B. yingjiangensis* are probably due to their similar rheophytic ecology and the associated adaptations of a rhizomatous habit and sturdy elongate leaves with a cuneate base. This growth form is found in four other species of *Begonia* from further south in the Malesian region, namely

B. abdullahpieei Kiew (Perak, Peninsular Malaysia), *B. fluvialis* M.Hughes (West Sumatra, Indonesia), *B. lilliputana* M.Hughes (Aceh, Indonesia) and *B. rhoephila* (Selangor, Peninsular Malaysia) (Kiew, 2005; Hughes *et al.*, 2015). *Begonia rhyacophila* Kiew is also found in a torrent habitat but has ovate leaves with a cordate base; however, Kiew (2005) notes that in times of flood, plants would be exposed to the full force of the waterfall torrents. There is no indication that these species form a natural group (*Begonia fluvialis* and *B. lilliputana* are in *Begonia* sect. *Jackia*, with the others all in *Begonia* sect. *Platycentrum*), suggesting a repeated evolution of a similar leaf shape.

Kingdon-Ward made five expeditions (described in Kingdon-Ward, 1921, 1924, 1930, 1949) to the areas north and east of Putao, but he collected *Begonia rheophytica* in only one place, noting it to be 'apparently local'. His successive specimen labels state the following: *Kingdon-Ward* 5561 (16 xi 1922): 'in the stream beds around the Nam Ti'; *Kingdon-Ward* 6633 (18 iv 1926): 'This species I saw, and probably collected in flower at the same spot in November 1922.'; *Kingdon-Ward* 7355 (9 ix 1922): 'Apparently local (collected previously)'. The collection number 6633 was later pencilled in on the last of these specimen labels to indicate that they belong to the same population. His last collection of *Begonia rheophytica* was made in 1937 (*Kingdon-Ward* 13567 [BM]), and for which it is noted, 'The Nam Ti valley is the only locality I know for this species'. The species even makes an appearance in Kingdon-Ward's book *From China to Hkamti Long* (1924) as he describes the forest on his descent from the hills to the Hkamti (Putao) plain: "In the rocks in the stream-bed grew masses of a curious but beautiful Begonia, with snow-white flowers, and very regular, lanceolate leaves." It is again described, 25 years later, in *Burma's Icy Mountains* (1949), where he writes, "The muddy path descends about 1000 feet to the Ti Hka on a slanting traverse, winding round the hillside and crossing several gushing torrents... Clumps of Begonia with long falchion-shaped leaves instead of the usual elephant ear grew in the rocky torrent beds. I have never met with this species anywhere else".

The label of the *Toppin* 4264 specimen names the locality somewhat vaguely as 'Upper Burma: Kachin Hills'. However, on a subsequent specimen separated by only eleven collection numbers (4275 of *Impatiens kamtilongensis* Toppin), the locality is given more specifically as: 'Kamti Long hills'. Kamti Long (or Hkamti Long) is the Shan name for the town that is now Putao, and the 'hills' may refer to the nearby Babulongtan mountain range, from where the other specimens were collected.

The sighting in 2001 and subsequent collection of *Armstrong* 3041 were also in more or less the same locality as the Kingdon-Ward collections, near Nam Ti, on the main trail between Putao and Naungmung, which crosses the Babulongtan mountain range, just to the south of Hkakaborzi National Park. Therefore, we suspect that all seven of the known specimens of this species were collected from the same catchment area, if not from the same population, and it is highly likely *Begonia rheophytica* is a very narrow endemic.

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APPENDIX

A CHECKLIST OF BEGONIA *SPECIES IN MYANMAR*

Specimen records are available from Hughes *et al.* (2015–).

Begonia* sect. *Alicida
Begonia alicida C.B.Clarke
Begonia tricuspidata C.B.Clarke
Begonia triradiata C.B.Clarke

Begonia* sect. *Apterobegonia
Begonia delicatula Parish ex C.B.Clarke

Begonia* sect. *Diploclinium
Begonia adscendens C.B.Clarke
Begonia brandisiana Kurz
Begonia burmensis L.B.Sm. & Wassh.
Begonia demissa Craib
Begonia discreta Craib
Begonia hymenophylla Gagnep.
Begonia josephi A.DC.
Begonia labordei H.Lév.
Begonia lushaiensis C.E.C.Fisch.
Begonia minicarpa H.Hara
Begonia modestiflora Kurz
Begonia parvuliflora A.DC.
Begonia picta Sm.
Begonia soluta Craib
Begonia subperfoliata Parish ex Kurz
Begonia surculigera Kurz

Begonia* sect. *Lauchea
Begonia adenopoda Lem.
Begonia crenata Dryand.
Begonia tenasserimensis Phutthai & M.Hughes

Begonia* sect. *Monophyllon
Begonia paleacea Kurz
Begonia prolifera A.DC.

Begonia* sect. *Parvibegonia
Begonia flaccidissima Kurz
Begonia integrifolia Dalzell
Begonia martabanica A.DC.

Begonia parishii C.B.Clarke
Begonia procridifolia Wall. ex A.DC.
Begonia sinuata Wall. ex Meisn.

Begonia* sect. *Platycentrum
Begonia acetosella Craib
Begonia annulata K.Koch
Begonia burkillii Dunn
Begonia cathcartii Hook.f.
Begonia difformis (Irmsch.) W.C.Leong, C.-I Peng & K.-F.Chung
Begonia discrepans Irmsch.
Begonia dux C.B.Clarke
Begonia flaviflora H.Hara
Begonia forrestii Irmsch.
Begonia foveolata Irmsch.
Begonia goniotis C.B.Clarke
Begonia griffithiana (A.DC.) Warb.
Begonia handelii Irmsch.
Begonia hatacoa Buch.-Ham. ex D.Don
Begonia hayamiana Nob. Tanaka
Begonia hemsleyana Hook.f.
Begonia iridescens Dunn
Begonia kachinensis Nob. Tanaka
Begonia kingdon-wardii Tebbitt
Begonia longifolia Blume
Begonia macrotoma Irmsch.
Begonia mariachristinae Wahlsteen
Begonia megaptera A.DC.
Begonia myanmarica C.-I Peng & Y.D.Kim
Begonia nepalensis (A.DC.) Warb.
Begonia obovoidea Craib
Begonia palmata D.Don
Begonia rex Putz.
Begonia rheophytica M.Hughes
Begonia rockii Irmsch.
Begonia roxburghii (Miq.) A.DC.
Begonia sandalifolia C.B.Clarke
Begonia siamensis Gagnep.
Begonia sikkimensis A.DC.
Begonia silletensis (A.DC.) C.B.Clarke

Begonia thomsonii A.DC.
Begonia togashii Nob. Tanaka & C.-I Peng
Begonia villifolia Irmsch.
Begonia wui-senioris C.-I Peng

Begonia* sect. *Reichenheimia
Begonia fibrosa C.B.Clarke
Begonia hymenophylloides Kingdon-Ward ex L.B.Sm. & Wassh.
Begonia nivea Parish ex Kurz