

Taxonomic identity of *Impatiens cathcartii* Hook.f. & *I. serratifolia* Hook.f. with notes on typification of both names

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Abstract. *Impatiens cathcartii* Hook.f. is recollected almost after a century, its taxonomic identity, description from fresh collection, coloured illustrations are made along with notes on typification of the name. Taxonomic identity of *I. serratifolia* Hook.f. along with its delimitation from closely related species is discussed, coloured illustrations with comparison of flowers with the closest species and notes on the typification of the name are also discussed.

Key words: Himalaya, *Impatiens cathcartii*, *Impatiens serratifolia*, recollection, taxonomic identity, typification

1. Introduction

The genus *Impatiens* L. (Balsaminaceae) consisting of over one thousand recognized species (Mabberley 2008; Gogoi *et al.* 2018) is distributed in tropical and subtropical regions of the Old World and in Northern temperate regions (Mabberley 2008). In India, the genus is distributed mainly in Eastern Himalaya and the Western Ghats and is represented by more than 210 taxa (Vivekananthan *et al.* 1997; Gogoi *et al.* 2018). Eastern Himalaya and North East India possess a wide variety of species of balsams but studies on the genus have long been neglected by taxonomists. Gogoi *et al.* (2018) published an illustrative account of 83 species, 1 variety and 1 naturalized and 2 cultivated species of this genus for Eastern Himalaya. However, there are still some species of which very little is known or have not been collected for long and their actual identity is not known properly. *Impatiens cathcartii* and *I. serratifolia* are two of such species whose recollection, actual identity, descriptions from fresh material along with coloured illustrations are presented in this paper for easy identification in the wild making it possible to take up proper conservation measures to protect these beautiful plants.

Sir J. D. Hooker, during his trip to India (1848-1850), botanized Sikkim Himalaya (including Darjeeling of present-day West Bengal state) and Khasi Hills. He collected a huge number of plants of which *Impatiens* became one of the groups that he studied with utmost care and attention. This resulted in a description of a number of new species that were published in numerous papers and books (Hooker 1875; 1904-1906; 1911; Hooker & Thomson 1860).

J. D. Hooker described *I. cathcartii* on the basis of his two specimens (K000694715 & K000694713) collected from Kurseong of Darjeeling Himalaya during his monumental trip to Sikkim Himalaya during 1848-1849 (Hooker 1875, 1904-1906). G. A. Gammie collected it from Labdah of Mungpoo area on 20th July 1889 (K000694714). Later on, the species was again collected by G. H. Cave (LBG 0490078-1/2 Lloyd Botanic Garden Herbarium, Darjeeling) on 15th May 1900 without specific locality from Darjeeling area, (E00848035) on 8th May 1912, (E00848039) on 17th Sept. 1918 and (E00848041) on 26th May 1923 all from Tista, (E00848037) on 8th June 1913 from Riang, (E00848040) on 2nd June 1919 from Lal and (E00848036) on 11th May 1920 from Sittong of Darjeeling; Prain's collector (P04614931) in July 1901 without specific locality

from Darjeeling, (LBG 0490078-1/1) in June 1903 and (E00848042) on 15th Nov. 1902 from Rishap of present day Kalimpong district; G. H. Cave (E00848038) on 30th Jul. 1913 collected from Labdah; I. H. Burkill (P04614930) on 1st June 1909 from Mamrim, Reaing Valley and (LBG 050080A-2/5) on 4th Aug. 1922 from Sittong of Darjeeling.

Grey-Wilson (1989) mentioned about few more collections of this species in his note on the *Impatiens jurpia* complex of the genus. C.B. Clarke collected this species on two occasions, one from Mungpoo in June 1871 & Sept. 1875 (*C. B. Clarke 11901* & *C. B. Clarke 24807* respectively); by J. S. Gamble from Kalimpong in July 1882 (*J. S. Gamble 10497*). However, Grey-Wilson did not mention about the herbarium in which these collections are extant, but it can easily be understood that these specimens are at K, although during this study only two specimens of J. D. Hooker (K000694715 & K000694713) and G. A. Gammie (K000694714) were available for study in Kew online portal. Considering all the facts above, it is clear that *I. cathcartii* Hook.f. was last encountered in its wild habitat on 26th May 1923 by G. H. Cave at Tista. While screening specimens in another herbarium there, we found few specimens from Myanmar at E (E00848140, E00848141, E00848142, E00848143, E00848144) which were wrongly identified as *I. cathcartii* Hook.f. and kept under the name but they were *I. duclouxii* Hook.f. and that is the reason why Ruchisansakun *et al.* (2018) did not report this species from Myanmar. Furthermore, Vivekananthan *et al.* (1997) reported *I. cathcartii* Hook.f. from Sikkim, Arunachal Pradesh and Meghalaya without any authenticated specimens which was erroneous; Hassler (2020) might have taken the data in their site from the above literature where they mentioned erroneous distribution of the species without proper validation. In the present study, all facts were examined thoroughly and reports of the distribution of the species were updated.

Grey-Wilson (1989), while writing his paper on the *I. jurpia* complex, with his arguments to delimit *I. cathcartii* from other allied species was based on the study done from earlier collections. While working with the *Impatiens* of Darjeeling & Sikkim Himalaya, one of the authors (NS) collected a species of *Impatiens* from Mungpoo area of Darjeeling Himalaya in 2015 and, after critical study with screening of the literature, the species turned out to be *I. cathcartii* Hook.f., which had long been in oblivion about its present status in the wild. One of the authors (RG) erroneously reported a yellow flowered *I. jurpia* Buch.-Ham. as *I. cathcartii* in his book "*Balsams of Eastern Himalaya*" (Gogoi *et al.* 2018) due to 2-7 flowered pendulous racemose inflorescence, yellow flowers, bucciniform lower sepal with reddish to pink tinged spur and dolabriform distal lobe

of lateral united petals. Its actual identity was always doubted because of its less known status due to long non-collection or any colour photographic evidences. As the plant was collected almost after a century, hence it is reported here along coloured illustrations for easy identification in the wild with detailed taxonomic characterisation with suitable keys for easy delimitation of the species from its close allies. Furthermore, lectotypification is also designated as there was a complexity regarding typification of this species.

2. *Impatiens cathcartii* Hook.f.

2.1. Taxonomy

Description: *Impatiens cathcartii* Hook.f., Fl. Brit. India. 1: 473. 1875 & in Rec. Bot. Surv. India. 4 (2): 20. 1905; Biswas. in Pl. Darj. Sikkim Himal. 1: 209. 1966; Grey-Wilson in Kew Bull. 44 (1): 117. 1989 & in Grierson & Long., (eds.) Fl. Bhutan 2 (1): 90. 1991; Vivek. *et al.* in Hajra *et al.* (eds.) Fl. India 4: 130. 1997; *auct. non.* Gogoi *et al.* Balsams East. Himalaya: 62. 2018. (Figs. 1, 3A-3C)

Lectotype (designated here): India: Korsiong, *s.d.*, *J.D. Hooker s.n.* (K000694715 image! lectotype; K000694713 image – isolectotype!).

Perennial herb 80 (-100) cm tall, stem erect, terete, much branched, nodes swollen, glabrous. Leaves alternate, petiole (0.4-)1.5-5.5 cm long; lamina ovate, 5.5-16×2.5-8 cm, apex acuminate, margins crenate, base cuneate with 2-4 stipitate glands, both surfaces glabrous. Inflorescence axillary 2-7 flowered pendulous raceme, peduncle slender, 4-6 (-10) cm long, glabrous; pedicel 1.5-3.5 cm long, glabrous, bracteate at the base. Bracts broadly ovate-suborbicular, 0.4-0.5×0.3-0.4 cm, apex acute, gland tipped, green, persistent. Flowers white to pale yellow flushed red, 3-3.5 cm long and 3.5 cm deep; lateral sepals 2, ±orbicular, 0.9-1.2×0.8-1.1 cm, apex gland tipped, fleshy, one-veined, white or red, glabrous; lower sepal bucciniform, 2-2.5 cm long and 1.8-2 cm deep excluding spur, abruptly constricted into a long incurved spur, mouth oblique, spur 1-1.3 cm long, flushed red; dorsal petal obcordate-suborbicular, 1.7-2×1.5-1.8 cm, apex emarginate, dorsally produced into an obtuse 3-5mm long keel, pale yellow speckled red; lateral united petals 2.8-3.8 cm long, basal lobe oblong, 0.9-1.2×1.8-2.4 cm, apex slightly emarginate, distal lobe dolabriform, 0.9-1.2×2-2.6 cm, obtuse, auricle oblong, yellow. Stamens 5. Ovary and fruit glabrous, capsule cylindrical, 3.5-4 cm long; seeds globose, glabrous.

Flowering: May-November (-December); Fruiting: June-December.

Distribution: India: West Bengal – Kurseong, Mungpoo, Rieng, Sittong and Tista of Darjeeling district; Rishap in Kalimpong district.

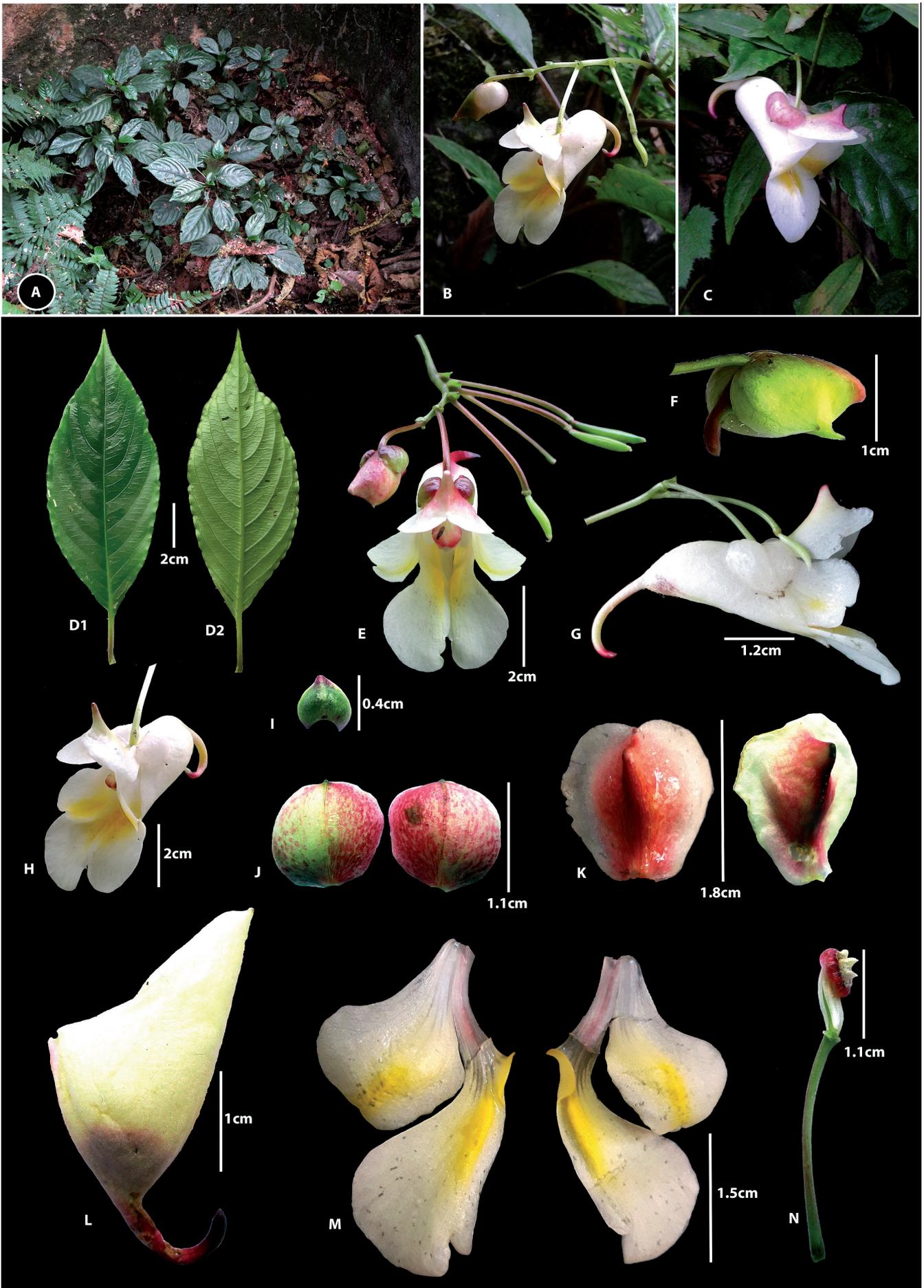


Fig. 1. *Impatiens cathcartii* Hook.f.

Explanations: A – plants in natural habitat, B – flowering twig, C & H – dorso-lateral view of flower, D1 – ventral view of leaf, D2 – dorsal view of leaf, E – inflorescence (flower bud, frontal view of flower & immature capsules), F – flower bud, G – lateral view of flower, I – bract, J – lateral sepals, K – dorsal petal, L – lower sepal, M – lateral united petals, N – stamens encircling the ovary & with pedicel

Habitat: This species grows in warm sub-tropical areas up to 1300 m a.s.l. near shady stream banks, roadsides under tree canopies and shady wasteland fringes.

Conservation: The species has a limited distribution in Darjeeling & Kalimpong district of West Bengal with scattered population, due to which it needs attention for conservation. Last year, one of the authors (NS) brought a healthy plant for ex-situ conservation at Botanical Survey of India's experimental garden at Gangtok (1600 m a.s.l.). Plants do not show healthy flowering behaviour in ex-situ conditions and flowers do not open fully. With the help of vegetative propagation, the species was raised to ca. 12 clumps.

Other specimens examined: India: West Bengal: Darjeeling, Simlay-Mungpoo, 750 m, 25th October 2015, *N. Sherpa* 251015 (BSHC); Sikkim: East Sikkim, Gangtok, BSI Experimental garden, 1600 m, 4th November 2019, *N. Sherpa* & *R. Gogoi* 41332 (BSHC00026361 & BSHC00026362).

2.2. Lectotypification

J. D. Hooker in 1875, described the *I. cathcartii* species from his own two collections made from Kurseong (Kurseong), Darjeeling Himalaya in 1848-49 viz., K000694715 & K000694713 without mentioning anything about holotype and isotype. In that sense, these two specimens are syntypes of the species. There is another barcode (K000694714) along with the specimen K000694713. The specimen K000694714 is a dissected part of flower collected by G. A. Gammie in 1889 and was added much later than publication of the species. Most probably somebody or J. D. Hooker himself, might have pasted Gammie's collection above the sheet of one of his own specimens i.e. K000694713 to see the reproductive characters easily. So Gammie's specimen could not qualify to be any type. Grey-Wilson (1989), while writing notes on *I. jurpia* complex, mentioned Hooker's two collections as holotype and isotype for *I. cathcartii* Hook.f., which is erroneous. But Art. 9.10 of Shenzhen Code (Turland *et al.* 2018) gives the provision in such cases that the specimens of *J. D. Hooker s. n.*, which were mentioned by Grey-Wilson as holotype and isotype, actually need to be designated as lectotypes. Hence, K000694715 image ! is designated here as lectotype and K000694713 image! as isolectotype.

Key to *I. cathcartii* and closely related species

- 1a. Lateral sepals 2 in single2
 1b. Lateral sepals 4 in 2 pairs4
 2a. Plants up to 40 cm tall; leaves 4-9×2-4 cm in size; peduncle maximum up to 4.5 cm long; spur of lower sepal involute***I. discolor***
 2b. Plants more than 60 cm tall; leaves 6-14×2-6 cm in size; peduncle more than 5.5 cm long; spur of lower sepal incurved or hooked but never involute3

3a. Plants glabrous; floral bracts broadly ovate-suborbicular, 4-5×3-4 mm; lateral sepals ±orbicular, 9-12 × 8-11 mm; dorsal petal with 3-5 mm long obtuse keel ..

.....***I. cathcartii***

3b. Plants hairy; floral bracts ovate to subulate, 2×1.5 mm; lateral sepals ovate or obliquely ovate, 3.5×2.5 mm; dorsal petal with 6-10 mm long acicular keel

.....***I. jurpia***

4a. Floral bracts ovate to lanceolate, 4-5×3-4 mm; smaller pair of lateral sepals terete, solid; lower sepal spur long, straight and then mildly curved, without red colouration

.....***I. laevigata***

4b. Floral bracts orbicular, strongly concave, 10×15 mm in size; smaller pair of lateral sepals long lorate; lower sepal with short abruptly curved hooked spur with a red tip

.....***I. pseudolaevigata***

3. *Impatiens serratifolia* Hook.f.

3.1. Taxonomy

Impatiens serratifolia Hook.f. was described by J. D. Hooker in 1905 again from his monumental expeditions to Sikkim Himalaya in 1849 (Hooker 1875, 1905). Initially, he reported his collection of this species from Lachung Valley of North Sikkim as *Impatiens serrata* Benth. ex Hook. f. & Thomson in 1860 (Hooker & Thomson 1860) and 1875 (Hooker 1875), may be due to distinct serrated leaves and white yellowish flower. Later, in 1905, Hooker realised it to be an undescribed species due to its long spur as compared to lack of spur in the lower sepal of the former. The species had been known very little among scientific circles and collected only on few occasions. It was found during the herbarium study in different herbaria, one collection housed at E found to be an authentic specimen of *I. serratifolia* Hook.f. (*KEKE 324*, E00848363 image!), a collection made from Kyapra to Pheri, Ghunsa Khola of NE Nepal in 1989 by Kew-Edinburgh-Kathmandu Expedition team. In E, another specimen (*Stainton, Sykes & Williams 17*, E00848364 image!) kept under this species from Bhadauri, East of Kumsa, Nepal collected on 17th Apr. 1954 definitely is not *I. serratifolia* Hook.f. due to the presence of infundibular lower sepal with long spur. Another collection housed at TI (*Stainton 1756*) collected on 21st Sept. 1956 from Arun Valley, Chyamtang, Nepal shows closeness to *I. serratifolia* Hook.f. but the shape and the size of flowers and spur in the specimen raise certain concern about its identity and it needs recollection for validation. From the above observation and critical studies, it is evident that the species *I. serratifolia* Hook.f., since its discovery, was collected only twice, once the type collection by Hooker himself in 1849 and by Kew Edinburgh Kathmandu Expedition team

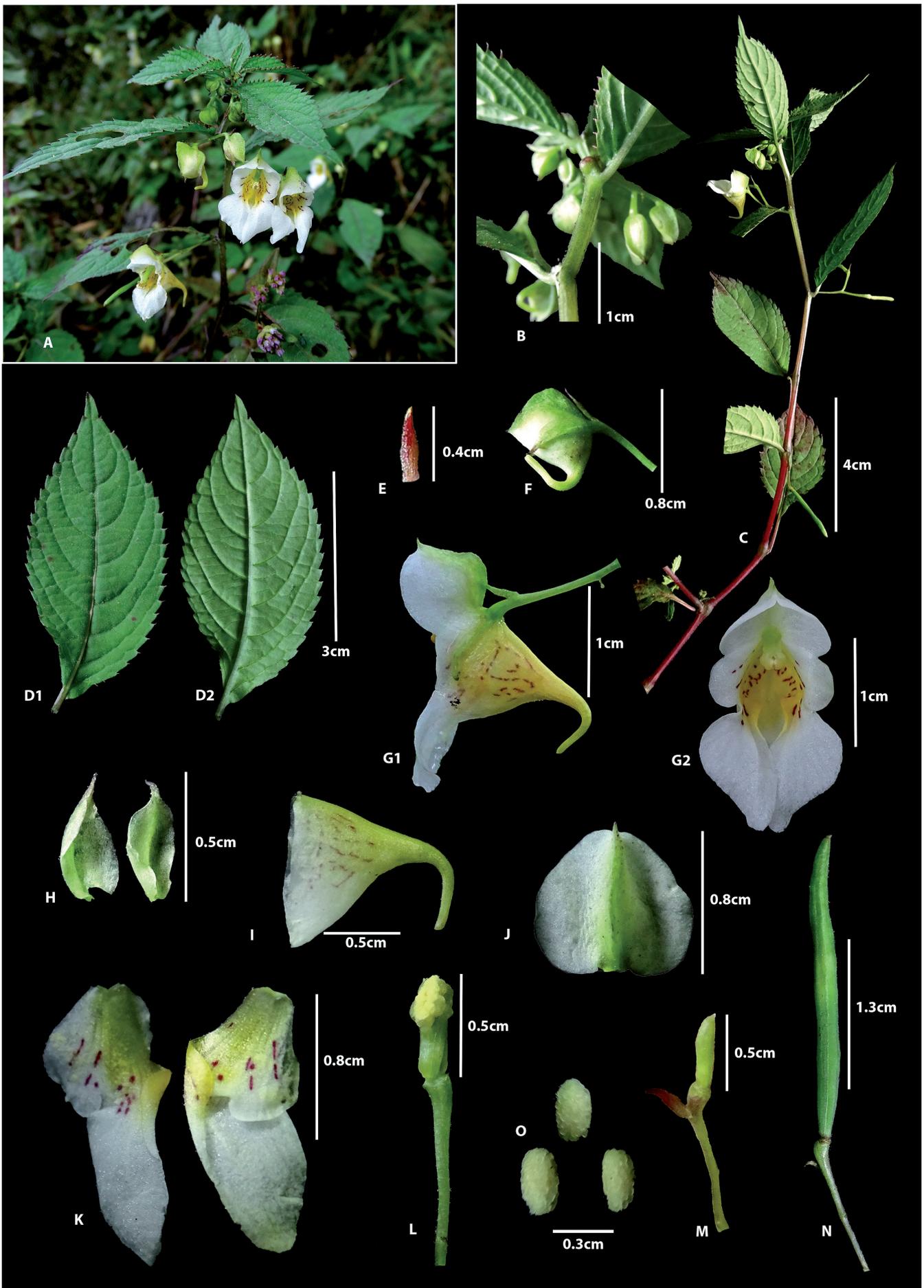


Fig. 2. *Impatiens serratifolia* Hook.f.

Explanations: A – plants in natural habitat, B – stem with close view of floral buds & stipular gland, C – flowering twig, D1 – ventral view of leaf, D2 – dorsal view of leaf; E – bract, F – flower bud, G1 – lateral view of flower, G2 – frontal view of flower, H – lateral sepals, I – lower sepal, J – dorsal petal, K – lateral united petals, L – stamens & pedicel, M – immature capsule along with pedicel, N – capsule, O – seeds

in 1989. In 2017, one of the authors (RG) collected a species of *Impatiens* from Lachung Valley, North Sikkim (*Gogoi 73706* at CAL) on 6th October 2017, which he reported, incorrectly, as *I. scabrada* DC. in the book “*Balsams of Eastern Himalaya*” (2018) because of similarity in shapes of lateral sepals, sub-bucciniform lower sepal and, more importantly, due to incurved spur. Subsequently, again in 2018 & 2019, the authors collected the species from Lachung and Lachen Valley of North Sikkim and it was ascertained that it was the species *I. serratifolia* Hook.f. which was collected from Lachung in 1849 by J. D. Hooker and described as a new species. Considering all the above facts and very little-known status of the species, it is reported here with coloured illustrations for easy identification in the wild with its key characters to delimit from its closely allied species in Himalayan region.

Description: *Impatiens serratifolia* Hook.f., Rec. Bot. Surv. India 4: 18. 1905; *I. serrata* Benth. ex Hook. f. & Thomson *auct. non*. Hook. f. & Thomson, J. Proc. Linn. Soc. Bot. 4: 136. 1860, *p.p.*, *auct non*, Hook.f., Fl. Brit. India 1: 473. 1875, *p.p.*; Grey-Wilson in Grierson & Long, Fl. Bhutan 2: 95. 1991; Vivek. *et al.* in Hajra *et al.* (eds.) Fl. India 4: 210. 1997; *I. scabrada* DC. *sensu* Gogoi *et al.* *Balsams East. Himalaya*: 152. 2018. (Figs. 2, 3J-3L)

Type: Lectotype (designated here, if not holotype): India: Sikkim, Lachung, 7-10,000 ft, 6th August 1849, *J. D. Hooker 89* (K000694938 image!).

Annual, not succulent herbs, sparsely branched, up to 40 cm tall, stem terete, nodes not swollen. Leaves distributed evenly along the stem, alternate; petiole 0.5-1 cm long, colour green; leaf blade elliptic, 2-7×0.7-2.5 cm, glabrous, base cuneate, sometimes slightly oblique, apex acuminate, margin serrate, stipule, glandular, purple, veins 6-12 pairs, sub opposite. Inflorescence axillary, peduncle, up to 1 cm long; flowers usually 2; bud greenish yellow. Flower - white flushed with yellow, with reddish markings, pedicel up to 0.7 cm long, green; bracts at the middle or at the top, linear lanceolate, green, persistent, up to 0.3 cm long, apex acute, midvein non-prominent, glabrous; lateral sepals – 2, ovate, green, up to 0.5×0.2 cm, apex acuminate, margin entire, partially transparent; lower sepal sub-bucciniform, yellow with gradually tapering to a down-curved spur, up to 0.7 cm deep, mouth non-beaked; spur greenish yellow, spur up to 0.7 cm long, tip greenish yellow; dorsal petal white with green ridge, widely ovate, up to 0.6-0.8 cm, apex emarginated to acute, not beaked, dorsally slightly raised; lateral united petals white with yellow blotch and red markings, up to 1.5 cm long, bilobed, subequal, basal lobe obovate, apex obtuse, not clawed, up to 0.5 cm long, up to 0.4 cm in width, distal lobe dolabriform, apex obtuse, up to 1 cm

long, up to 0.5 cm in width, auricle minute, up to 0.2 cm long. Stamen 5, united, enclosing ovary, up to 0.4 cm long. Capsule linear, green, up to 2.5-3 cm long, up to 1.5 mm in width. Seeds few, 0.2×0.1 cm in size, surface papillate.

Flowering: July-October; **Fruiting:** August-November.

Distribution: India: Sikkim, Lachung Valley (type locality), North Sikkim; Lachen Valley, North Sikkim; Nepal: Kyapra to Pheri, Ghunsa Khola of N.E. Nepal; Central & East Nepal.

Habitat: This species grows commonly in high-altitude areas at ca. 2500-3000 m a.s.l. at roadsides or as weed in potato fields, paddy fields and kitchen gardens.

Other specimens examined: India: Sikkim, North Sikkim, Lachung to Katao Road, 2700 m, 16th August 2019, *R. Gogoi & N. Sherpa 41110* (BSHC-053891 & BSHC-053892); North Sikkim, Lachen, 2700m, 22nd August 2018, *R. Gogoi 73645* (BSHC).

Note: The species, which was reported as *I. serratifolia* Hook.f. (Gogoi *et al.* 2018), is a completely different species and, presently, it is under investigation with the help of molecular data for its true identity.

3.2. Lectotypification

J. D. Hooker initially reported his collection from Lachung *Hooker 89* (K000694938 collected in 1849 as *I. serrata* Benth. ex Hook.f. & Thomson (Hooker & Thomson 1860, Hooker 1875), which was a mixture of a few collections (his own collection from Sikkim, Wallich's collection from Nepal and Griffith's collection from Bhutan) in the Proceedings of the Linnean Society of London (1860) and in the first volume of Flora of British India in 1875. Later on, he realised that his collection from Sikkim was an undescribed taxon different from other collectors used to describe *I. serrata* in FBI, and described as *I. serratifolia* Hook.f. in 1905. While describing the species, he only mentioned “*partim; Fl. Brit. Ind.: 1: 473*” without mentioning any specimens, which means it was solely based on only one collection by J. D. Hooker himself from Lachung (*Hooker 89*: K000694938) which is still extant at K and it matches completely the protologue. The only specimen at K is probably a holotype; in case it is not, it is designated here as lectotype of *I. serratifolia* Hook.f.

Key to *Impatiens serratifolia* and closely related species

- 1a. Lower sepal with distinct spur2
- 1b. Lower sepal spurless4
- 2a. Capsules less than 1.5 cm long, ridges verrucose; lateral united petals 4 lobed*I. quadriloba*
- 2b. Capsules more than 2.5 cm long, ridges smooth; lateral united petals 2 or 3 lobed3

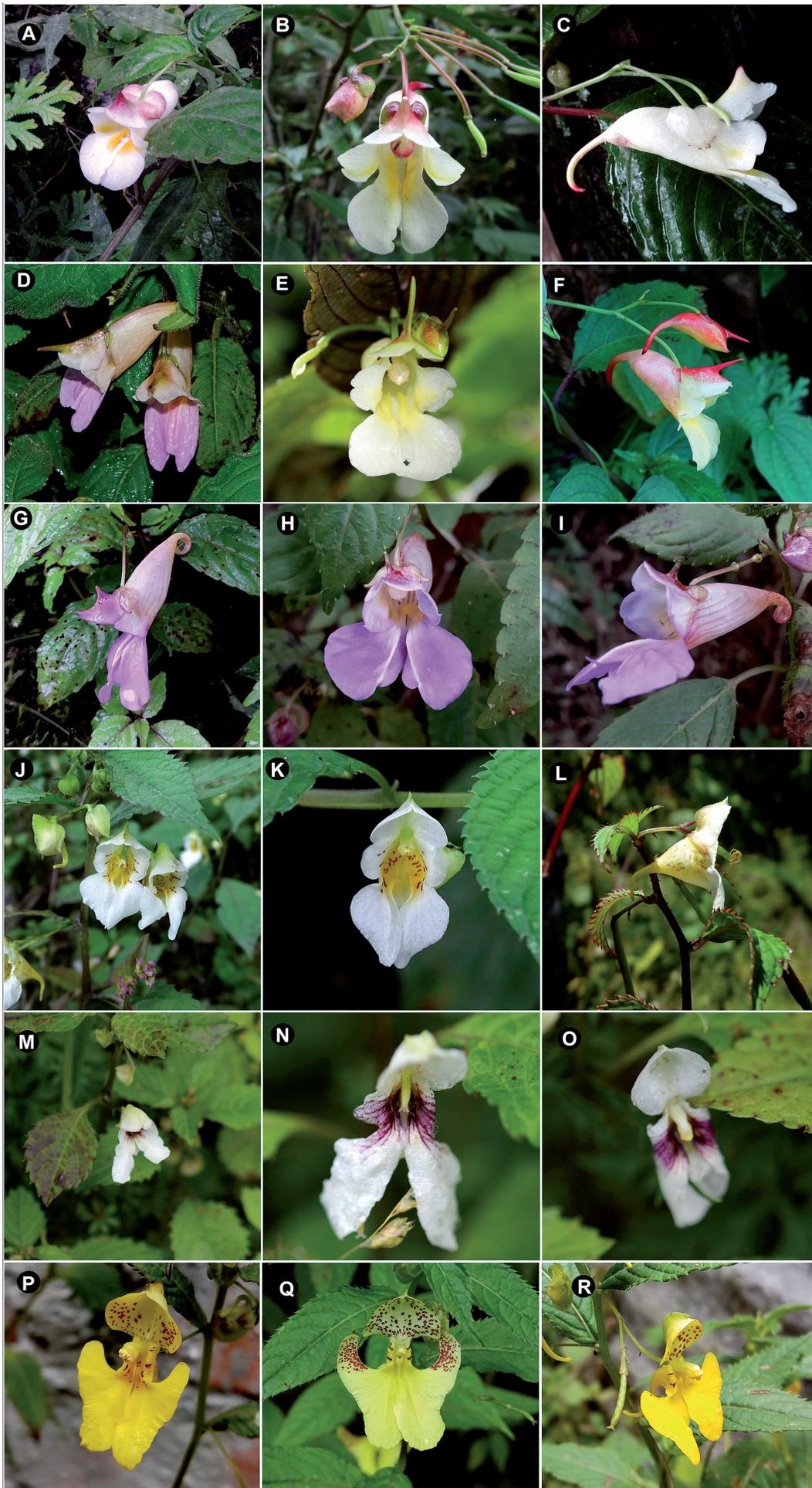


Fig. 3. Comparison of flowers of *I. cathcartii* and *I. serratifolia* with closely related species
 Explanations: A-C – *I. cathcartii*, D-F – *I. jurpia*, G-I – *I. discolour*, J-L – *I. serratifolia*, M-O – *I. serrata*, P-R – *I. falcifera*. A, D, G, J, M, P – dorso-lateral views of flowers; B, E, H, K, N, Q – front views of flowers; C, F, I, L, O, R – lateral views of flowers. Photographs M-O by Saroj K. Kasaju

- 3a. Distal lobe of lateral united petals falcate; lower sepal navicular with long downcurved spur up to 3 cm long *I. falcifera*
 3b. Distal lobe of lateral united petals dolabriform; lower sepal widely funneliform with incurved spur up to 1 cm long *I. serratifolia*
 4a. Leaf 2-5 cm long; flower white with deep purple blotch, size more than 3 cm long *I. serrata*
 4b. Leaf 1-1.8 cm long; flower white to pale yellow, size less than 2 cm long *I. kharensis*

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 Data analysis and interpretation: R. Gogoi & N. Sherpa
 Drafting the article: N. Sherpa
 Critical revision: R. Gogoi
 Final approval: R. Gogoi

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