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云南凤仙花属一新种及一新记录种

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摘 要: 报道了在云南西南部发现的凤仙花属一新种——滇红凤仙花(*Impatiens quintadecimacopii* G. W. Hu & Q. F. Wang)和一新记录种——伸展凤仙花(*I. porrecta* Wall. ex Hook. f. & Thomson)。这两个种在形态上很相似, 但在花色、侧萼片形状、旗瓣形状和蒴果颜色上明显有别。根据形态特征, 这两个种应属于凤仙花亚属(*I.* subg. *Impatiens*)单花组(*I.* sect. *Uniflora*)。结合核糖体DNA内转录间隔区序列(ITS)与叶绿体*atpB-rbcL*间隔区序列开展系统发育分析, 结果进一步确认了这两个种关系紧密, 以及它们在单花组内的系统位置。

关键词: 凤仙花属; 新种; 新记录; 系统发育; 分类学; 中国

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A new species and a newly recorded species of *Impatiens* (Balsaminaceae) from Yunnan, China

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Abstract: *Impatiens quintadecimacopii* G. W. Hu & Q. F. Wang *sp. nov.* is described and *I. porrecta* is reported as a new record from southwestern Yunnan province of China. These two species are close in morphology but can be distinguished by color of flowers, shape of lateral sepals and upper petals, and color of capsules. Morphological characters of these two species indicate they belong to sect. *Uniflora* in *I.* subg. *Impatiens*. Phylogenetic analysis of a combined dataset from nuclear ITS and plastid *atpB-rbcL* sequences confirmed their close relationship and their phylogenetic placement in sect. *Uniflora*.

Key words: *Impatiens*; New species; New record; Phylogeny; Taxonomy; China

Impatiens L. (Balsaminaceae) is one of the largest genera in angiosperms and includes more than 1000 species worldwide[1-3]. *Impatiens* species are mainly distributed in tropical and subtropical Eurasia and Africa[1, 4]. Phylogenetic studies indicate the origin of the genus in southeast Asia or southwest China and rapid diversification and radiation since the early Pliocene[1, 2, 5]. Based on molecular studies with support from morphological characters, *Impatiens* is

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currently divided into two subgenera: *I.* subg. *Clavicarpa* S. X. Yu ex S. X. Yu & Wei Wang and *I.* subg. *Impatiens*, the latter further divided into seven sections[3]. However, the relative uniformity of vegetative and reproductive characteristics and considerable species diversity still pose great challenges for the classification of this genus.

In October 2011, during a field investigation in Yingjiang county near the China-Myanmar border of southwestern Yunnan, an *Impatiens* species with unique pink flowers and pilose hairs was collected. After a preliminary review of relevant literature and collections, it could not be correctly identified to any known species from China, although it was similar to a yellow-flowered species collected during a field survey in Tengchong county in southwestern Yunnan in August 2007. This yellow-flowered *Impatiens* had also remained unidentified for us for many years. To undertake further observations of these two unidentified species, field surveys were carried out in southwestern Yunnan in June and July 2019. Adequate materials and specimens of both species were collected from the same places. After detailed literature review[6-13], specimen examination, and phylogenetic analysis, we determined that the yellow-flowered *Impatiens* was *I. porrecta* Wall. ex Hook. f. & Thomson, which has been recorded from Myanmar, Laos, India and south Tibet[12-15]. A further check of the specimens of this species revealed several specimens of this species collected during 1910s – 1930s from Yunnan, while they had been ignored or misidentified as other species. Based on the historical collections and our collections, we report *I. porrecta* as a newly recorded species in Yunan province, China. However, for the pink-flowered species, although similar to *I. porrecta* in overall features and structure of inflorescences and flowers, the colors of flowers and capsules and the shapes of the lateral sepals and lateral upper petals are obviously different. Based on careful morphological study and phylogenetic analysis, we conclude the pink-flowered species are different from all other known species of *Impatiens*. Therefore, we describe it herein as a new species.

1 Materials and Methods

1.1 Morphological observations

Morphological description of the new species was based on observations of fresh materials and herbarium specimens. The morphological description of *I. porrecta* was based on descriptions from the literature[12, 13, 16] and observations on the newly collected materials. The terms used for describing the flower structure follow those of Grey-Wilson[5]. Specimen images were checked through the Global Biodiversity Information Facility (GBIF, https://www.gbif.org/), JSTOR Global Plants (https://plants.jstor.org), Chinese Virtual Herbarium (CVH, http://www.cvh.ac.cn/), Edinbrugh Herbarium Catalogue (http://data.rbge.org.uk/search/herbarium/), and Specimens Database of the Herbarium of Institute of Botany, CAS (http://pe.ibcas.ac.cn/#).

1.2 Taxa sampling, DNA extraction, sequencing, and phylogenetic analyses

In total, 59 species of *Impatiens* and one species of *Hydrocera* as the outgroup were included for phylogenetic analysis. The sequences of 58 species were downloaded from GenBank. For the two newly collected species (voucher specimens *HGW-1200* & *HGW-1206*), genomic DNA was extracted from silicone gel-dehydrated leaf tissue using a Mag-MK Plant Genomic DNA Extraction Kit (Sangon Biotech, Shanghai). Nuclear ITS and plastid *atpB-rbcL* sequences were amplified following methods used in previous studies[1, 2]. Polymerase chain reaction (PCR) products were sequenced by TSINGKE Biological Technology, Wuhan, China. GenBank accession numbers are provided in Table 1.

Table 1　Taxa used for phylogenetic analysis and their GenBank accession numbers

Species	GenBank accession number	
	ITS	*atpB-rbcL*
Impatiens amoena H. Perrier	AY348795	
I. andohahelae Eb. Fisch. & Rahelivololona	AY348741	
I. andringitrensis H. Perrier	AY348742	
I. anovensis H. Perrier	AY348743	
I. aureliana Hook. f.	AY348747	DQ147814
I. auricoma Baill.	AY348748	DQ147815
I. balsamina L.	AY348749	DQ147816
I. baronii Baker	AY348751	
I. begoniifolia S. Akiyama & H. Ohba	AY348752	DQ147819
I. bequaertii De Wild.	AY348753	DQ147820
I. bombycina W. Lobin & E. Fischer	AY348755	
I. burtonii Hook. f.	AY348757	
I. campanulata Wight	AY348758	DQ147822
I. chinensis L.	AY348761	DQ147825
I. chlorosepala Hand.-Mazz.	KP776067	KP776017
I. columbaria J. J. Bos	AY348764	DQ147828
I. conchibracteata Y. L. Chen & Y. Q. Lu	AY348765	DQ147829
I. congolensis G. M. Schulze & R. Wilczek	AY348766	DQ147830
I. cordata Wight	AY348768	
I. cuspidata Wight & Arn.	AY348769	DQ147832
I. duclouxii Hook. f.	KP776071	KP776021
I. firmula Baker	AY348780	
I. fuchsioides H. Perrier	AY348785	
I. furcata H. Perrier	AY348786	
I. gibbosa H. Perrier	AY348787	
I. gongshanensis Y. L. Chen	KP776074	KP776024
I. henslowiana Arn.	AY348790	
I. hians Hook. f.	AY348791	DQ147849
I. hoehnelii T. C. E. Fr.	AY348792	
I. hunanensis Y. L. Chen	KP776077	KP776028
I. inaperta H. Perrier	AY348797	DQ147852
I. keilii Gilg.	AY348798	KP776029
I. kilimanjari Oliver	AY348800	
I. leschenaultii Wall.	AY348803	DQ147856
I. levingei Gamble ex Hook. f.	AY348804	
I. manaharensis Baill.	AY348805	
I. mengtzeana Hook. f.	AY348806	DQ147858
I. meruensis Gilg.	AY348807	DQ147859
I. miniata Grey-Wilson	AY348809	
I. monticola Hook. f.	AY348810	DQ147860
I. napoensis Y. L. Chen	AY348811	DQ147861
I. niamniamensis Gilg.	AY348812	DQ147862
I. parasitica Bedd.	AY348815	
I. percrenata H. Perrier	AY348817	
I. platypetala Lindl.	AY348819	DQ147868
I. porrecta Wall. ex Hook. f. & Thomson	**MT160748**	**MT164535**
I. pseudoviola Gilg.	AY348822	DQ147871
I. putaoensis Y. H. Tan, S. S. Zhou & B. Yang	MF802807	MF802806
I. quintadecimacopii G. W. Hu & Q. F. Wang	**MT160749**	**MT164536**
I. sambiranensis H. Perrier	AY348829	
I. sodenii Engl. & Warb. ex Engl.	AY348832	DQ147879
I. stuhlmannii Warb.	AY348836	

续表 1

Species	GenBank accession number	
	ITS	*atpB-rbcL*
I. subabortiva H. Perrier	AY348837	
I. trichosepala Y. L. Chen	AY348843	DQ147885
I. tuberosa H. Perrier	AY348844	DQ147886
I. vilersi Costantin & Poisson	AY348848	
I. walleriana Hook. f.	AY348849	DQ147892
I. xanthina H. F. Comber	AY348850	DQ147893
Hydrocera triflora (L.) Wight & Arn.	KC905460	DQ147895

Note: New sequences generated in this study are in bold.

Sequence assembly and editing were conducted in MEGA v7.0.26[17]. MAFFT v7.222[18] was used for alignment. Ambiguously aligned fragments of sequences were removed using Gblocks[19]. Suitable DNA substitution models of Bayesian inference phylogenies were selected based on MrModeltest v2.3[20]. Bayesian inference phylogenies were inferred using MrBayes v3.2.6[21] under the GTR + I + G model (two parallel runs, 10 million generations, sampled every 100th generation), with the initial 25% of sampled data discarded as burn-in. Maximum-likelihood phylogeny was performed in PhyloSuite v1.1.16[22] and ModelFinder[23] was used to select the best-fit model based on AICc criterion. The best-fit model according to AICc was TN + F + R3. Maximum-likelihood phylogenies were inferred using IQ-TREE[24] under the best-fit model for 1000 ultrafast bootstraps[25].

2 Taxonomic Treatment

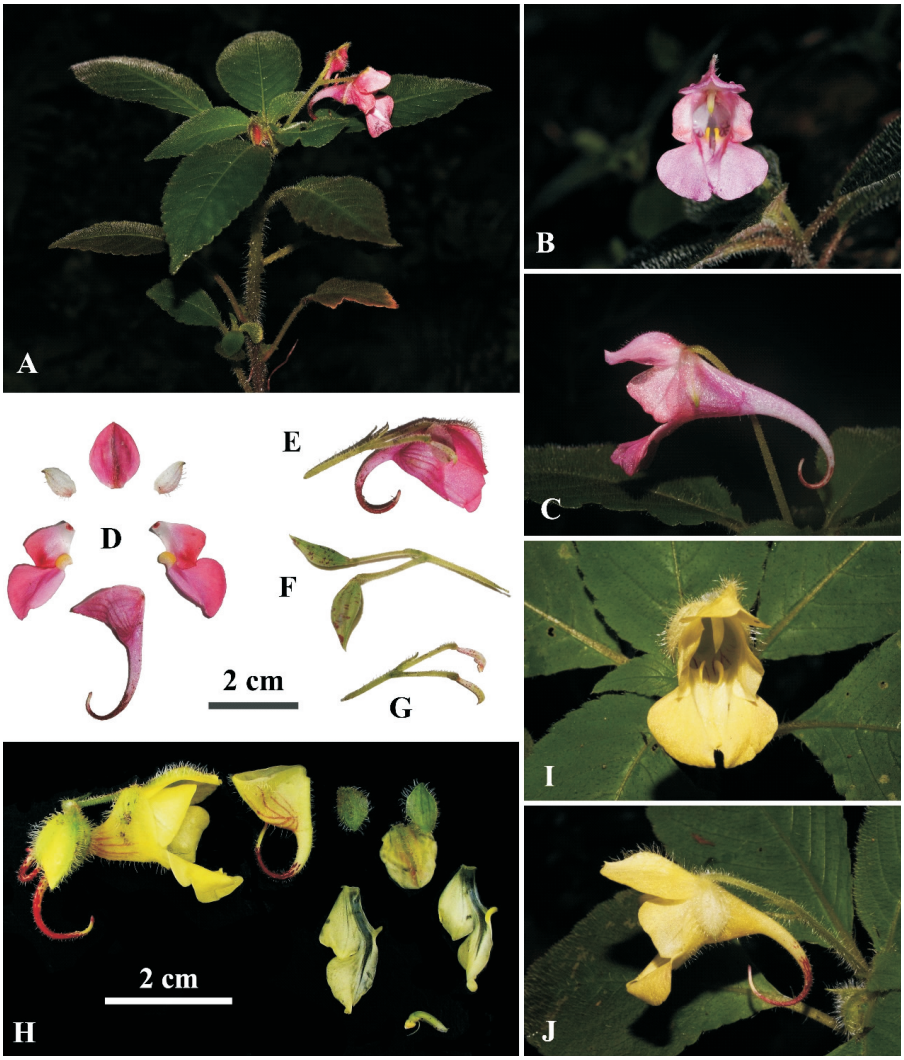
2.1 滇红凤仙花(新种, Fig. 1: A–G, Fig. 2)

Impatiens quintadecimacopii G. W. Hu & Q. F. Wang, *sp. nov*. Fig. 1: A–G, Fig. 2.

Diagnosis: The new species is similar to *I. porrecta* in overall features of plants and structure of inflorescences and flowers. However, it can be easily distinguished from the latter by the following characteristics: flowers pink with red spots; lateral sepals translucently white with base pinkish and apex greenish; incurved spurs 2.0 – 2.5 cm, pink with red spots at apex; capsules green with dark red spots.

Type: China. Yunnan province: Yingjiang county, Xima Township, near China-Myanmar border, in evergreen broad-leaved forests, 24°47′N, 97°40′E, elev. 1540 m, 28 July 2019, *G. W. Hu*, *S. Peng et J. J. Wang HGW-1200* (holotype: HIB!, isotype: HIB!).

Description: Annual herb, up to 25 cm tall, densely pubescent, usually green, sometimes purple. Stem erect, sometimes slightly procumbent in lower part, succulent, densely pilose. Leaves spirally arranged, with 2 or 3 pairs of stipitate glands at base of lamina and on upper petiole; petioles 0.5 – 3 cm long; lamina ovate to elliptic-lanceolate, 2.0 – 8.0 × 1.5 – 4.0 cm, pilose on both sides, base obtuse to cuneate, apex acute or attenuate, margin coarsely crenate, teeth mucronulate, lateral veins 5 – 8 pairs. Inflorescences axillary, a fascicle usually with 2 flowers. Peduncles pubescent, 1 – 2 cm long. Pedicel pubescent, 1.0 – 1.5 cm long, 1-bracteate at base. Bracts linear-lanceolate, 5 – 8 mm long. Flowers pink, 3 – 4 cm long. Lateral sepals 2, translucently white with base pinkish and apex greenish, lanceolate to elliptic, 7 – 9 × 3 – 5 mm, with 3 – 5 veins, puberulent, apex mucronulate. Lower sepal pink with 5 – 6 red stripes on each side, bucciniform, 1.0 – 1.5 cm deep, mouth 1.1 – 1.6 cm wide, gradually narrowed into incurved spur; spur ca. 2.0 – 2.5 cm, pink with red spots at tip. Dorsal petal elliptic to suborbicular, 1.3 – 1.6 × 0.9 – 1.2 cm, apex emarginate



A：Habit；B：Flower (front view)；C：Flower (lateral view)；D：Different parts of flower；E：Flower bud；F：Capsule；G：Ovary；H：Inflorescence and different parts of flower；I：Flower (front view)；J：Flower (lateral view). All photographed by Guang-Wan Hu.

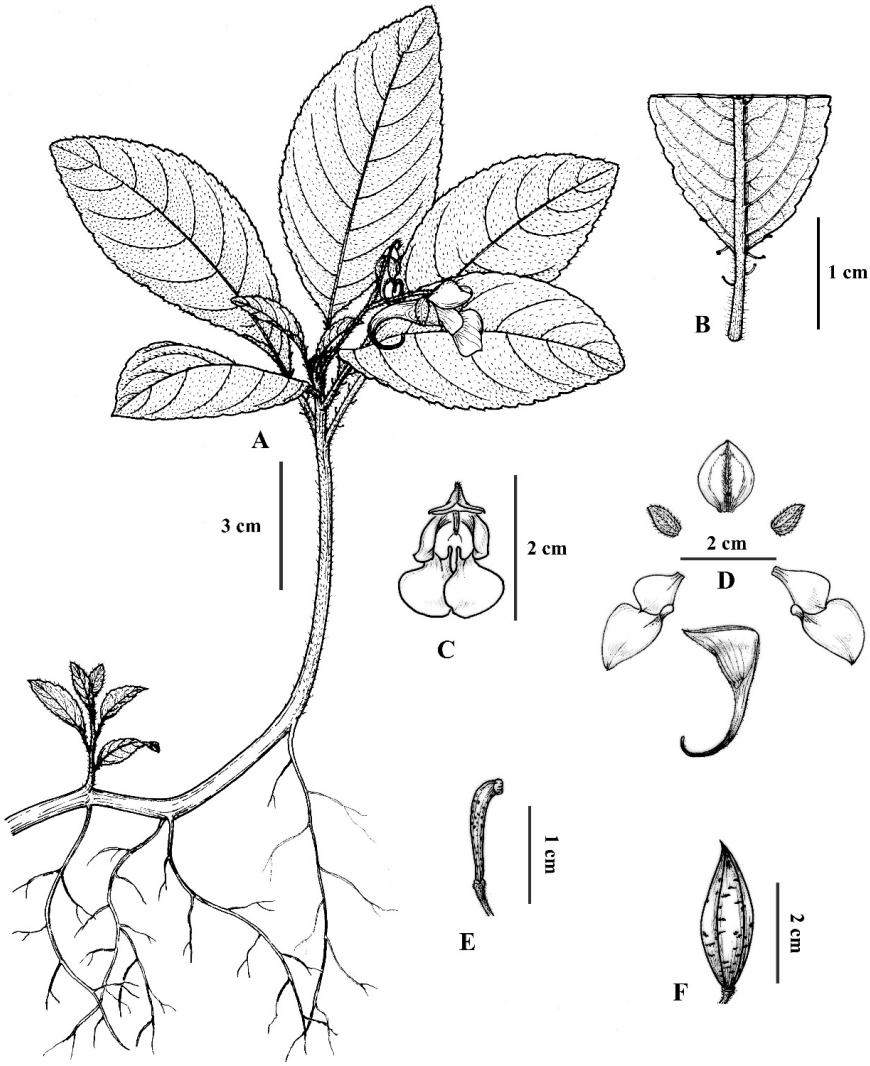
Fig. 1　Morphology of *Impatiens quintadecimacopii* G. W. Hu & Q. F. Wang (A–G) and *I. porrecta* Wall. ex Hook. f. & Thomson (H–J)

and mucronulate, dorsally with red narrow arcuate cristate crest, crest sparsely puberulent. Lateral united petals 2.0 – 2.5 cm long, lobes 2; upper petals free, dolabriform, 1.0 – 1.3 × 0.6 – 1.0 cm, pink but diaphanous along inner margin, apex rounded; lower petals free, subtriangular semicircle, 1.2 – 1.5 × 0.8 – 1.1 cm, pink, base inner margin curled into small yellow auricle, with slight emargination along inner margin. Ovary 5-carpellate, red-spotted. Capsule shortly fusiform, ca. 16 mm long, 6 mm broad at middle, green with dark red spots.

Distribution and ecology: The new species is currently known only from the type locality near the China-Myanmar border in Yingjiang county, Yunnan, China. It grows in moist areas in evergreen broad-leaved forests.

Etymology: The specific epithet "*quintadecimacopii*" is derived from the Fifteenth Meeting of the Conference of the Parties of the United Nation's Convention on Biological Diversity (CBD COP15). This species is named for this upcoming conference, which will be held in Kunming, Yunnan, China in 2021.

Phenology: The new species was observed flowering and fruiting from June to November



A: Habit; B: Abaxial surface of leaf lower half; C: Flower (front view); D: Different parts of flower; E: Ovary; F: Capsule. All from holotype (HIB). Drawn by Jing Tian.

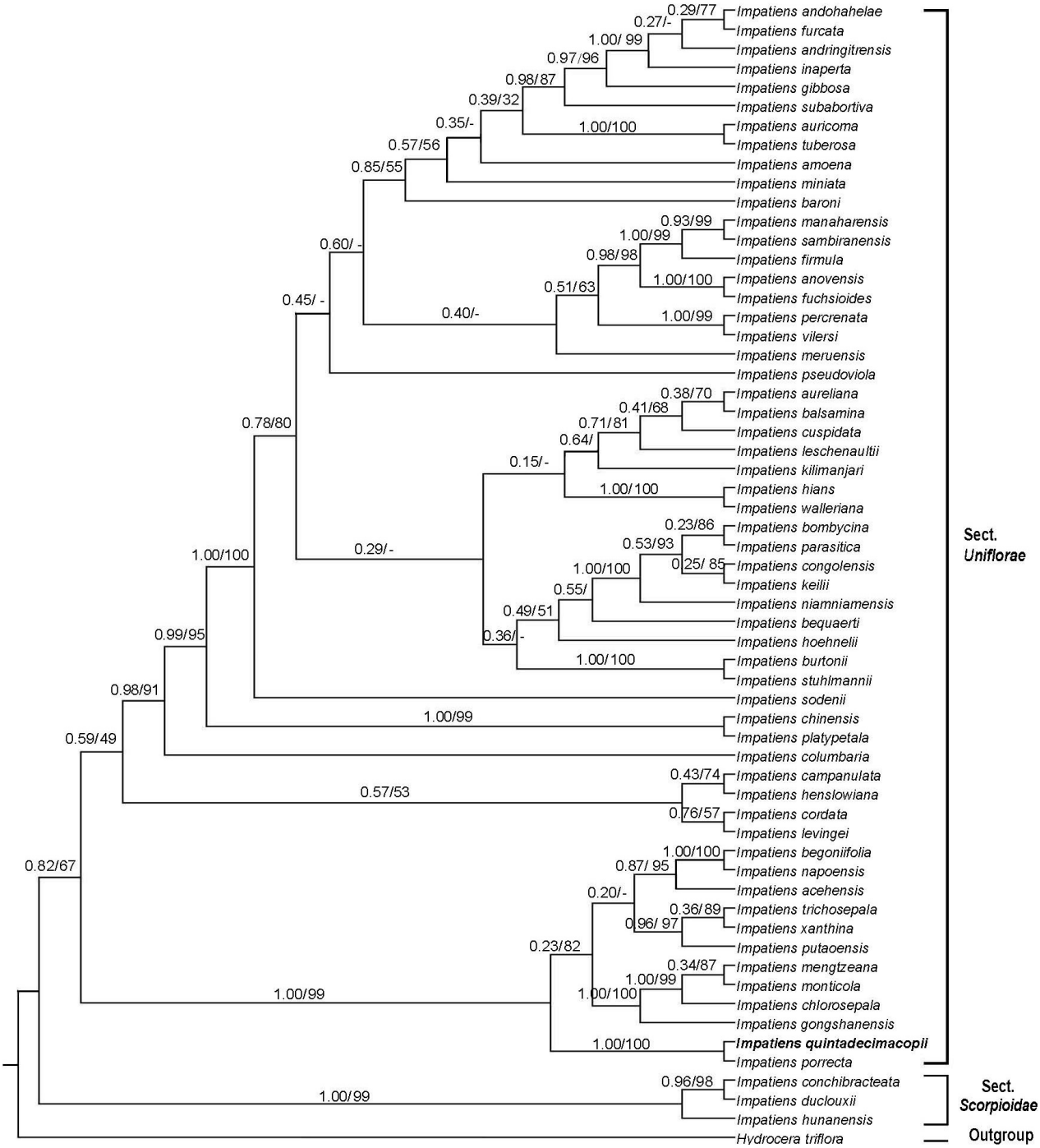
Fig. 2 *Impatiens quintadecimacopii* G. W. Hu & Q. F. Wang

during field investigations.

Phylogenetic analysis: Phylogenetic analyses of the combined DNA sequences (ITS and *atpB-rbcL*) verified the position of the new species in *Impatiens* sect. *Uniflora* (Fig.3). This is consistent with the morphological characteristics, i.e., inflorescences with flowers 2, lateral sepals 2, ovary 5-carpellate, capsule short-fusiform and conspicuously turgid at middle. *I. quintadecimacopii* and *I. porrecta* formed a subclade with high support (posterior probability (PP) and bootstrap percentages (BP) of subclade of 1.00/100), indicating that the two species are not only morphologically similar but also evolutionarily close.

Affinities: The new species is similar to *I. porrecta* in ovate to elliptic leaves, (1)–2–(3)-flowered inflorescence, bucciniform lower sepals with red spots, size of lateral united petal, and shortly fusiform capsule. However, the new species can be distinguished from *I. porrecta* by the pink (vs. yellow) flowers, translucently white (vs. wholly green or whitish yellow) lateral sepals with base pinkish and apex greenish, dolabriform lateral upper petals 10 – 13 × 6 – 10 mm (vs. obovate, 8 × 7 mm), and capsules with (vs. without) dark red spots.

The new species is also very similar to *I. kha-*



Posterior probability (PP) from Bayesian inference analysis and bootstrap percentages (BP) for maximum-likelihood (ML) analysis are shown on branch (PP_{BI}/BP_{ML}). "–" indicates $BP_{ML} < 50$ or $PP_{BI} < 0.50$.

Fig. 3　Phylogenetic tree based on combined dataset of nuclear ITS and plastid *atpB-rbcL* DNA sequences

siana Hook. f. and *I. toppinii* Dunn (sometimes treated as a variety of the former species[12]) on the structure and size of flowers which are known from India and Myanmar[12, 26, 27]. However, plants of *I. khasiana* are erect and taller (up to 80 cm vs. up to 25 cm), having 8 – 13 (vs. 5 – 8) pairs of lateral veins on leaves, purple (vs. pink) flowers, green lateral sepals with purplish base (vs. translucently white with base pinkish and apex greenish), and lower sepals with 10 – 12 (vs. 5 – 6) stripes on each side and with white (vs. pink) spur. Plants of *I. toppinii* are only

slightly pubescent apically (vs. wholly densely pubescent), having purple flowers with whitish yellow spur, glabrous (vs. pilose) lateral sepals ca. 13 mm long (vs. 6 – 9 mm long), ovaries and capsules without (vs. with) purple spots.

Other specimens examined (paratypes): China. Yunnan province: Yingjiang county, same place as holotype, 27 October 2011, *G. W. Hu et al. HGW-0911* (HIB); Ibid., 19 June 2019, *G. W. Hu et al. HGW-2022* (HIB).

2.2 伸展凤仙花(新拟, Fig.1: H–J)

Impatiens porrecta Wall. ex Hook. f. & Thomson, J. Proc. Linn. Soc., Bot. 4 (no. 15): 116, 138 (1859); Hook. f., Fl. Brit. Ind. 1: 472 (1875) & J. Linn. Soc., Bot. 37 (257): 29, 31 (1904) & Rec. Bot. Surv. India 4 (2): 33 (1905); Toppin, Bull. Misc. Inform. Kew 1920 (10): 352, fig. (1920); Bernardi, Candollea 18: 254 (1963); Hajra *et al.*, Mat. Fl. Arunachal Pradesh 1: 253, fig. 73 (1996); Vivek. *et al.*, Fl. India 4: 195, fig. 47 (1997); N. P. Singh *et al.*, Fl. Manipur 1: 199 (2000); N. P. Singh *et al.*, Fl. Mizoram 1: 293 (2002); G. D. Pal, Fl. Lower Subansiri Distr., Arunachal Pradesh 1: 167 (2013); Ruchis. *et al.*, Blumea 63(3): 251, pl. 4d (2018). ≡ *Impatiens porrecta* Wall., Numer. List: n. 7275 (1832), nom. nud.

= *Impatiens bella* Hook. f. & Thomson, J. Proc. Linn. Soc., Bot. 4 (no. 15): 116, 138 (1859); Hook. f., Fl. Brit. Ind. 1: 458 (1875); P. K. Hajra *et al.*, Mat. Fl. Arunachal Pradesh 1: 248 (1996). Type. India: Meghalaya, Khasi hills, "Khasia", *Griffith s. n.* (lectotype, K [K000694775], image seen!, designated by Ruchisansakun *et al.*, Blumea 63: 251. 2008; isolectotype, NY [04028831], image seen!); "Khasia", *T. Lobee s. n.* (syntype, K [K000608266], image seen!); "Khasia", near to Kalapane, elev. 1219 – 1524 m, 6 August 1850, *J. D. Hooker & T. Thomson* 92 (syntypes, BR [BR0000021452314], K [K000608265 & K000608267], L [L0388754 & L0388756], M[M0211773], MPU [MPU019010], NY [04028832], P [P04542855, P04542857, P05029171], U[U. 1149125], US[03471711], images seen!).

Type: Bangladesh: Sylhet, "Silhet", *W. Gomez s. n.* (Wall. Cat. no. 7275) (lectotype K [K001127061], image seen!, designated by Ruchisansakun *et al.*, Blumea 63: 251. 2008; isolectotype, E[E00841634], image seen!); India, "Khasia", elev. 1219 m, *J. D. Hooker & T. Thomson 91* (possible syntype, L [L0249362], image seen!).

Description: Annual herb, 10 – 45 cm tall. Stem erect to procumbent, branching in decumbent part, densely pilose especially towards apex, sometimes nearly glabrous on lower part. Leaves spirally arranged; petioles 5 – 25 mm long, densely pilose and distally with 1 or 2 pairs of glandular hairs; lamina ovate to elliptic, 10 – 45 × 10 – 28 mm, slightly attenuate into petiole at base, acuminate at apex, finely crenate-serrate along margins with lowermost teeth filiform, pubescent on both surfaces, lateral veins 4 – 10 pairs. Inflorescence axillary, erect, 1–3-flowered. Peduncles 7 – 35 mm long, densely pilose. Flowers orange to yellow, 15 – 30 mm long, 20 – 40 mm deep. Bracts linear to lanceolate, 2 – 4 × 1 – 2 mm, apex acute, base cuneate, margin entire, densely pilose, persistent. Pedicel 9 – 30 mm long, pilose. Lateral sepals 2, free, green or whitish yellow, ovate to narrowly ovate, 6 – 9 × 2.5 – 5 mm, apex acute to acuminate, base obtuse to cuneate, pilose to densely pilose. Lower sepal bucciniform, yellow with dark red reticulated lines, pilose, 25 – 40 mm long, 6 – 15 mm deep, gradually constricted into curved to incurved spur, spur yellowish with red spots at apex, 17 – 30 mm long. Dorsal petal elliptic to orbicular, 10 – 14 × 8 – 11 mm, cucullate, apex round to emarginate, base obtuse, dorsal midvein with pilose crescent-shaped crest. Lateral united petals 17 – 22 mm long, free; upper pet-

als obovate to obovate-triangular, 11 × 7 mm, apex obtuse, base cuneate; lower petals suborbicular or elongate-obovate, ca. 10 – 12 × 6 – 8 mm, apex obtuse, base auricled. Stamens ca. 5 mm long. Ovary pilose, ca. 5 mm long. Capsules shortly fusiform, 8 – 12 mm long, pilose.

Distribution and ecology: Nepal, India (Assam, Manipur, Meghalaya, Mizoram, Nagaland & Sikkim States), Bangladesh (Sylhet), Myanmar (Chin & Kachin States), Laos (Muang Curm), China (Yunnan province, new record; South Tibet). It grows near the streams or in humid areas of evergreen forest at elevations 600 – 2750 m.

Phylogenetic position: Phylogenetic studies indicate that *I. porrecta* is in *Impatiens* sect. *Uniflora*, and has a close relationship with *I. quintadecimacopii*. These two species cluster with several species distributed in Southeast Asia forming a subclade in sect. *Uniflora* (Fig. 3).

Note: This species has also been recorded in south Tibet[28] (called "Arunachal Pradesh" in India). We did not see any specimens collected from that region. The lectotype of *I. porrecta* was collected from Sylhet, formerly included in Assam, now part of Bangladesh.

Specimens examined: China. Yunnan province: —Fugong Co.: N'maikha-Salwin divide, 26°40′N, elev. 2743 – 3048 m, moist situations by streams in thickets, August 1919, flowers orange-yellow, *G. Forrest 18262* (E[E00120102]). —Tengchong city: Hills to the northwest of Tengyueh, 25°5′N, elev. 1829 m, moist stony pasture by streams, June 1912, flowers bright golden yellow, *G. Forrest 7992* (E[E00120094 & E00120095]); Hills N. W. of Tengyueh, 25°10′N, 98°36′E, elev. 2134 m, on very shady banks in side valley, August 1924, flowers pale organe or yellow, *G. Forrest 24818* (E[E00120100], IBSC[0184288], PE[01879218]); Hills N. W. of Tengyueh, 25°30′N, elev. 2438 m, moist meadows on the margins of streams, June 1931, flowers golden yellow, *G. Forrest 29806* (E[E00120103], PE[01879217]); Tengyueh, *E. B. Howell 174* (E[E00120106]); Tengyueh, *E. B. Howell 124* (E[E00120107]); Shweli-Salwin divide, 25°30′N, elev. 2743 m, moist situations by streams, July 1913, flowers pale yellow, purplish towards base, *G. Forrest 12012* (E[E00120097], PE[01879219]); Shweli-Salwin divide, 25°40′N, 98°45′E, elev. 2134 – 2438 m, margins of shady thickets in side valleys, June 1924, flowers golden orange, *G. Forrest 24581* (E[E00120101], PE[01879220]); Shweli-Salwin divide, 25°30′ N, 98°48′ E, elev. 2438 m, on shady mount banks in side valley, August 1924, flowers pale yellow, *G. Forrest 24823* (E[E00120099], IBSC[0184287], PE[01879222]); Shweli-Salwin divide, 25°45′N, 98°58′E[Possibly some errors in coordinate numbers because they show the current locality in east of Salwin River in Lushui county.], elev. 2438 – 2743 m, marshy meadows and amongst scrubs by streams, September 1924, flowers deep orange-yellow, *G. Forrest 25243* (E[E00120098], PE[01879221]); Shweli valley, 25°30′N, elev. 2438 m, shady situations by streams, August 1913, flowers pale yellow, *G. Forrest 11989* (E[E00120096], PE[01879216]); Mt. Yunfeng, 25°23′N, 98°25′E, elev. 1760 m, 23 August 2007, *G. W. Hu et al. HGW-0179* (HIB); ibid., elev. 1800 m, 29 July 2019, *G. W. Hu*, *S. Peng et J. J. Wang HGW-1206* (HIB).

3 Discussion

The new species and newly recorded species were both discovered in Yunnan province, Southwest China, which is a diversity hotspot for the distribution of *Impatiens*. These two species are not only similar in morphological characteristics and phylogenetic positions and are also distributed in adjacent areas. Detailed morphological comparisons between *I. quintadecimacopii* and *I. porrecta* are shown in Table 2.

Table 2 Comparisons of morphological characters between *Impatiens quintadecimacopii* and *I. porrecta*

Character	*I. quintadecimacopii*	*I. porrecta*
Inflorescence	2-flowered	1–3-flowered
Flower color	Pink	Orange to yellow
Lateral sepal color	Translucently white with base pinkish and apex greenish	Green or whitish yellow
Dorsal petal	13 – 16 mm long	9.5 – 14 mm long
Lateral united petal	20 – 25 mm long	16.5 – 22 mm long
Upper petal	Dolabriform, 10 – 13 × 6 – 10 mm	Obovate, 8 × 7 mm
Lower petal	Subtriangular semicircle, 12 – 15 × 8 – 11 mm	Ovate, 10 – 12 × 6 – 8 mm
Capsule	Green with dark red spots	Green

For *I. porrecta*, besides our new collections, there are several old collections made during 1910s – 1930s by George Forrest (1873 – 1932) and E. B. Howell (1899 – 1912 working for Tengyueh Customs) in southwestern and midwestern Yunnan. Those specimens are mostly deposited at Edinburgh Herbarium (E) with some duplicates at Herbarium (PE), Institute of Botany, CAS and Herbarium (IBSC), South China Botanical Garden, CAS. The specimens at E are correctly identified and do not seem to have been previously checked by Chinese taxonomists. Those duplicates at PE have been misidentified as *I. kamtilongensis* Toppin which differs *I. porrecta* on the distinct prostrated appendage on dorsal petal. Those deposited at IBSC have been misidentified as *I. lasiophyton* Hook. f. which belongs to sect. *Impatiens* having linear or cylindrical capsules[3]. We also found a specimen *G. Forrest 15848* (E[E00752419]) collected from western Yunnan in 1917 was very likely to be *I. quintadecimacopii.* The plants have much denser and longer hairs and the flowers are somewhat pinkish seen from the dry specimens and lateral sepals with a mucronate tip in deep color. This specimen needs more detailed checking for identification.

Through careful literature review and phylogenetic study and analysis, we found some species (including *I. andersonii* Hook. f., *I. cuspidifera* Hook. f., *I. khasiana* Hook. f., *I. putaoensis*, *I. pulchra* Hook. f., *I. kamtilongensis*, *I. mengtzeana* Hook. f. and *I. toppinii* Dunn) are closely related to *I. quintadecimacopii* and *I. porrecta*. For example, *I. khasiana* was once named under a variety of *I. bella* Hook. f., while *I. bella* is now treated as a synonym of *I. porrecta*[29]; some syntype specimens of *I. mengtszeana* (e.g., *A. Henry 9268*, *12536C*, *12536D*) had once been identified as *I. porrecta*. These species are similar in plant height, flower color (usually yellow or pink), lower sepal form, lateral united petal shape, and fruit shape and size, but different in flower size, lateral sepal morphology, and dorsal petal shape. Detailed comparisons of morphological features are needed to distinguish them. Further specimen studies would find more collections for *I. quintadecimacopii* and *I. porrecta* from China and neighboring countries.

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