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Rediscovery and taxonomic notes of an endemic species, *Impatiens viridiflora* wight (Balsaminaceae) from southern western ghats, India

S Karuppusamy, V Ravichandran, M Uday Kumar
Department of Botany, The Madura College (Autonomous), Madurai, Tamil Nadu, India

Abstract
Impatiens viridiflora Wight (Balsaminaceae), a narrow endemic species of southern Western Ghats has been rediscovered from Megamalai Wildlife Sanctuary of Theni district, Tamil Nadu after the lapse of 185 years. A taxonomic treatment, morphological variations, distribution, diversity status, threat assessment, ecology and phenology of the species are provided along with a colour photograph for the first time.

Keywords: *Impatiens viridiflora*, rediscovery, endemic species, diversity status, conservation

Introduction
Impatiens L. (Balsaminaceae) is one of the largest and interesting genera in India with maximum endemism of *ca*. 280 species with disjunct distribution in Himalaya and Western Ghats which altogether constitute the major centres of diversity [1]. The Western Ghats is home to 130 species, of which 124 species are endemic especially many numbers of species concentrated over the southern Western Ghats that have been categorized under seven sections [2]. During plant exploration of Megamalai Wildlife Sanctuary (now the part of Megamalai- Sri Villiputhur Tiger Reserve) of Tamil Nadu, first two authors (SK & VR) located the population of an interesting epiphytic Balsam on the evergreen trees of Vattaparai area of the Wildlife Sanctuary. After critical study of the collected specimens, perusal of the relevant literature [3-8]. and comparison with herbarium specimens of other allied species housed at K, it was identified as *Impatiens viridiflora* Wight and the present collection of the species is a rediscovery after a gap of 185 years. For easy identification of *I. viridiflora* and to understand its distinction from the other related species, comparison of the floral character with their morphovariants are presented in this communication.

Materials and Methods
I. viridiflora Wight was described based on collection made by SK & VR from Megamalai Wildlife Sanctuary of Tamil Nadu. Since its collection in 1837 [3] from the Sivagiri hills (Sri Villiputhur Wildlife Sanctuary) of Tamil Nadu, no further authentic collection has been made. This species is only known from the three original materials housed at K (K000694878, K000694879, K00069880), collected probably by Wight and another one sheet deposited at BM herbarium (BM012558203) without collector name and locality. Recently the specimen K000694879 was designated as lectotype by Singh [9] and other two specimens considered as residual syntypes because of without mentioned any precise collection locality.

Taxonomy
Impatiens viridiflora
Wight, Madras J. Lit. Sci. ser. 1, 5: 9. 1937; Singh, Phytotaxa 268(3): 167, 2016 [Lectotype: INDIA. Tamil Nadu: Shevagerry [Sivagiri] hills, s.d., Wight 348, K000694879!]; Hook.f., Fl. Brit. India 1: 460. 1874; Gamble Fl. Pres. Madras 1: 139(99), 1915; Vivek *et al*., in Hajra *et al*., Fl. India 4: 226. 1997; Muktesh, Epiphytic Fl. Western Ghats 62. 1998.

Perennial, epiphytic herbs. Stems erect, cylindrical, woody below, thick, up to 2.5 cm dia., leaf-scar prominent, herbaceous above, succulent, rarely branched, glabrous. Leaves cauline, alternate, crowded at the top of the stem, lanceolate-oblong to ovate-elliptic, 3.0-7 x 2-3.5 cm, base cuneate to obtuse, margins crenate-dentate, sinus of the crenation with minute pink cilia, apex obtuse to acuminate, lateral veins 4-5; petiolate, petiole 1-2 cm long, exstipulate, sometimes with pinkish stipular glands on the petiole. Inflorescence resupinate, axillary subumbellate, peduncled, peduncle equal or slightly longer than the petiole, 3-5 cm long, cylindrical, yellowish to pinkish, 2-3-flowered. Flowers bisexual, zygomorphic, pedicellate, 2.5 cm across, bracts persistent or caducous, sepals 3 or rarely 5, imbricate, 2 lateral ones flat, small, linear lanceolate-ovate, usually green, posterior sepal large, petaloid, bag-shaped, spurred; petals 5, free, green, red, scarlet, purple or white, upper standard petal, flat, prominently keeled, usually lobed, lateral ones, fused in pairs, entire or lobed, sometimes with slender appendage at the base; lip saccate, characteristically wrinkled, laterally compressed, narrowed into a stout involute spur, 2.5 x 0.9 cm; standard small, 0.7 x 0.9 cm, orbicular, 2-lobed, back strongly keeled, crowned with large erect foliaceous crest, yellow-netted veins prominent; wing petals fleshy, 2-lobed, lateral lobes hidden under standard, terminal oblong, rounded, 8 x 5 mm. Stamens 5, alternating with petals, fused towards the apex, somewhat like a ring surrounding the style and stigma, filaments broad and short, anthers bi-locular, whitish yellow. Ovary 5 locular, oblong-ovoid, ovules many, uniseriate in each cell, style single, very short, stigma 5 celled, sessile. Capsule asymmetrical,

fusiform, swollen in the middle, obtuse at base, acute at apex, glabrous, loculicidally dehiscing by 5 valves. Seed ovate, 3 x 2 mm, flattened, tuberculate, brownish, albumen absent (Fig. 1).

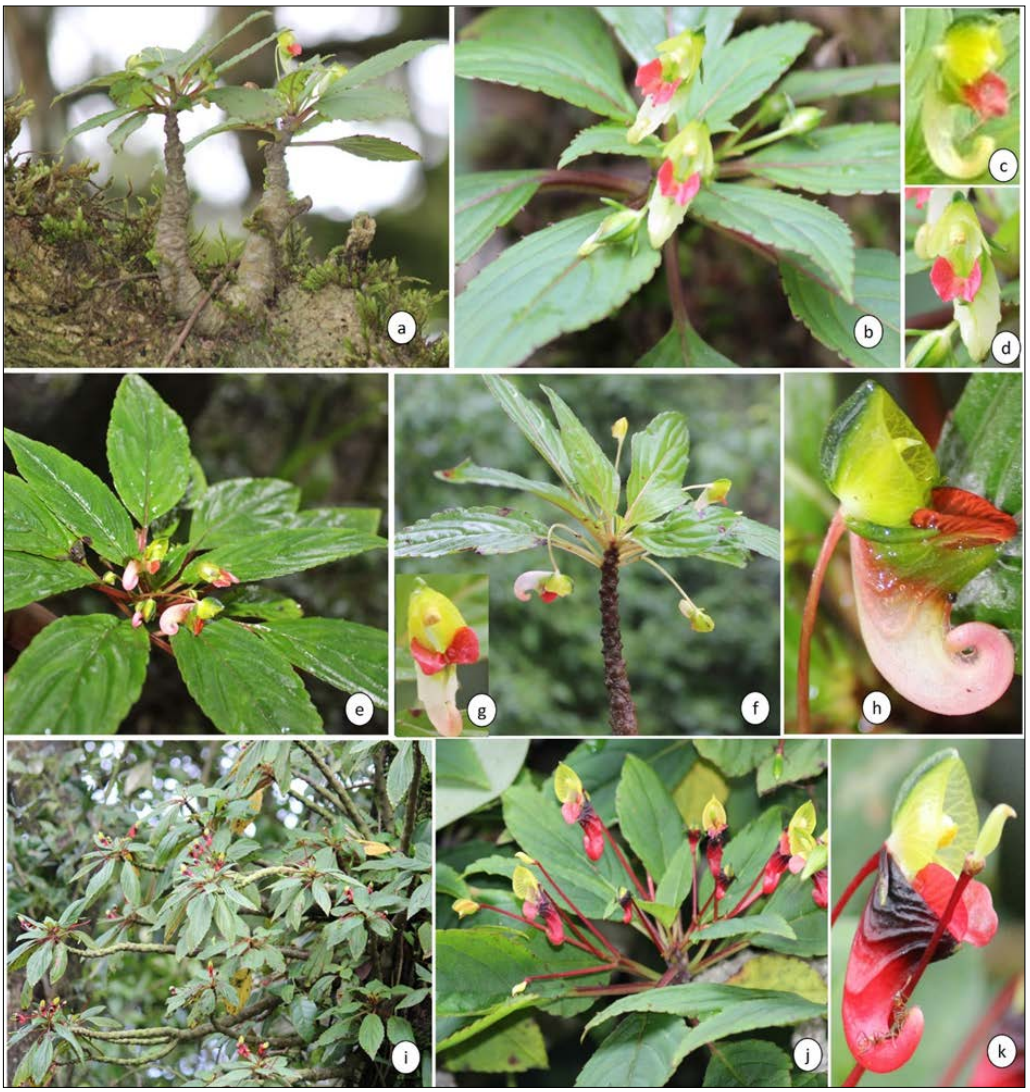

Fig 1: *Impatiens viridiflora* Wight, a-d; Original variety with greenish white spur with rose pink lateral petal lobes, e-h; Morphovariant of rose-pink spur with scarlet red lateral lobes; i-k: Robust variety of scarlet spur with pink lobes of lateral petals.

Morphological variations

Morphologically three different variants are observed in the native range of *I. viridiflora*. As described in protologue, the original population is exhibiting in Shivagerry hills (now Srivilliputhur Wildlife Sanctuary) which is a typical *I. viridiflora* named by Wight (1938). The plants with stout, short stem, *ca*. 20 cm long with prominent leaf scar, apically crowded leaves bearing axillary 2-3-flowered cymes. Flowers greenish, except the tip of lip scarlet or rose coloured, lateral petals forming connate mouth frontally, pedicel yellowish, slightly curved (Fig.1. a-d). Whereas in other two different morphovariant populations were existing in Megamalai Wildlife Sanctuary of same stretch in the Western Ghats which exhibits robust population of the species with remarkable variations. A group of individuals in Brook peak and Vattaparai of Upper Manalaru showed that greenish-white curved spur, pale green lateral petals and standard petals without rose or reddish mouth of connate lateral tips (Fig.1. e-h). The nature of the spur is varying with typical *viridiflora*, and other population showed very dense and robust leaves with axillary long reddish peduncled cymes. Flowers almost red except the standard petal, by looking it is very similar to *I. parasitica*. Spur is dark-red with darker almost blackish near the mouth. Lateral petals are scarlet reddish or deep rose coloured (Fig.1. i-k).

Distribution

It grows epiphytically on evergreen forest trees of *Actinodaphne malabarica* Balakr., *Antidesma menasu* (Tul.) Miq., *Bhesa indica* (Bedd.) Ding Hou, *Casearia rubescens* Dalz., *Elaeocarpus munronii* (Wall.) Masters, *Melicope lunu-ankenda* (Gaertn.) T.G.Hart., *Gomphandra tetrandra* (Wall.) Sleum., *Litsea floribunda* (Bl.) Gamble, *Syzygium densiflorum* (Wall.) Wight & Arn., *Symplocos monantha* Wight and *Vernonia monosis* Benth. at an elevation 1500 – 1700 m msl in Virudhunagar and Theni districts of Tamil Nadu.

Notes

I. viridiflora, presumably a narrow endemic species, make confusion among botanists because of the lack of collections after its type collection [2]. In many occasions *I. parasitica* has also been treated as *I. viridiflora* by mistake [10]. *I. viridiflora* differs from similar species by its connate lateral

petals with rose-pink coloured rounded tips, green, rose or red coloured laterally compressed spur with tubular curved tip. The present study recognized the *I. viridiflora* is closely allied to *I. parasitica*, *I. jerdoniae*, *I. violacea* and *I. sholayarense* but it is an unambiguous species which was not collected so far after its type collection.

Phenology

Flowering initiate after the set of north-east monsoons in late August and peak of flowering in rainy days from September to November. Fruit set is observed from October to December. After February the plants withdrawn the leaves, rigid erect leafless stems with dormant tips remains until June. In showers of south-west monsoon starts in June onwards, young crowded leaves flushed on the tips and started expanding in each leaf axile emerged the inflorescence with forked tip and usually two and rarely 3-flowered at the maturity.

Diversity status

I. viridiflora has been encountered in the Megamalai Wildlife Sanctuary of Theni District and Srivilliputhur Grizzled Squirrel Wildlife Sanctuary of Virudhunagar District of Tamil Nadu including types collection. Except the Wight's record (*l.c.*) no other authentic specimens housed in any Indian herbaria for identification. The present record provides the distribution of this species narrowly in Megmalai and adjoining Shivagiri hills around 50 Km^2 radius with countable number of populations on evergreen shola trees above 1500 m altitude.

Threat assessment

Based on the present collection, about 5 different subpopulations has been located in 25 clumps with not more than 300 mature individuals. The extent of occurrence (EOO) was calculated as 560 km2 and the area of occupancy (AOO) was estimated as 50 km2 (Criterion B) by taking the minimum grid size of 2 × 2 km using http://geocat.kew.org/ online platform. Although the species is presently known from Megamalai Wildlife Sanctuary and Srivilliputhur Grizzled Squirrel Sanctuary, both are protected areas, the location falls within the core zone of the reserve, even though it is anthropogenically quite active due to the occurrence of the area is very close to tea and cardamon cultivations. The habitat is under a constant pressure of anthropogenic influences like clearing of forests for tea cultivation and from soil erosion. Therefore, the threat status of this species as per IUCN [11] guidelines is assessed as "Endangered" [EN B1ab(iii)+2ab(iii)].

Specimen examined

India, Tamil Nadu, Megamalai Wildlife Sanctuary, Theni district, Vattaparai, 1650 ft., November 2017, *S. Karuppusamy & V. Ravichandran 1926* (SGH); Book's peak, 1730 ft. November 2017, *S. Karuppusamy & V. Ravichandran 1944* (SGH); Vattaparai, September 2019, *S. Karuppusamy & M. Uday Kumar 2361* (SGH); Shivagerry hills [Shivagiri hills], s.d., *Wight 345* (K [lectotype K000694879]); Shivagerry hills [Shivagiri hills], *Wight 310* (K000694878); *Wight s.coll*. without number and loc. (K000694880); without collector name and loc. (BM012558203).

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