

***Impatiens* (Balsaminaceae) species from karst limestone in Kelantan, Malaysia, including three new species**

R. Kiew

Forest Research Institute Malaysia, Kepong 52109,
Selangor, Malaysia
ruth@frim.gov.my

ABSTRACT. Peninsular Malaysian *Impatiens foxworthyi* M.R.Hend. is distinct from the Thai *I. opinata* Craib. Three new *Impatiens* species are described: *I. glaricola* Kiew with purple flowers, *I. chikuensis* Kiew with pale yellow flowers, and *I. vinosa* Kiew with deep red flowers. While *Impatiens foxworthyi* is widespread on karst limestone in Kelantan and Pahang, the three new species are narrowly endemic to Kelantan limestone and are critically endangered.

Keywords. Balsams, conservation assessments, Peninsular Malaysia

Introduction

The last account for balsams from Peninsular Malaysia was by Shimizu (1970) who recorded 14 species, of which only one, which he called *Impatiens opinata* Craib, was from Kelantan. Examination of the type of *Impatiens opinata* shows that the Kelantan balsam is distinct from it and should be called *I. foxworthyi* M.R.Hend. (see below). During a survey of limestone hills in Kelantan, three new species came to light (Davison & Kiew, 1990). They are described and illustrated here. Two resemble *Impatiens foxworthyi* in having racemose inflorescences, while the third has flowers singly from the leaf axils.

Impatiens foxworthyi is a striking balsam with bright canary-yellow flowers with deep crimson spots in the throat and its leaves often have a white midrib and veins. The new species exhibit a range of flower colours from pale creamy yellow with scarlet spots (*I. chikuensis*), or pale purple (*I. glaricola*) or deep ruby red flowers (*I. vinosa*), the last a unique colour for Malaysian balsams. All grow at the base of or in damp shaded gullies on karst limestone hills and the three new species are all critically endangered as a result of their narrow distributions, small population size, habitat disturbance, and lack of protected status of the limestone hills where they grow. *Impatiens foxworthyi* is widespread on several limestone hills in Kelantan, as well as in Pahang.

Key to balsam species in Kelantan

- 1a. Flowers purple, single from the leaf axils 3. *I. glaricola*
- 1b. Flowers creamy yellow, bright yellow or deep red, arranged on long racemes ... 2

- 2a. Leaves with 5–7 veins on either side of the midrib, intercostal veins distinct and parallel to the lateral veins; flowers deep ruby red 4. *I. vinosa*
- 2b. Leaves with 3–4 veins on either side of the midrib, intercostal veins obscure; flowers creamy yellow or bright yellow 3
- 3a. Leaf margin teeth tipped by a long glandular hair; flowers bright canary-yellow, petals lobes not reflexed, lower lip expanding 2. *I. foxworthyi*
- 3b. Leaf margin teeth not tipped by a glandular hair; flowers creamy yellow, petal lobes reflexed and oblong 1. *I. chikuensis*

1. *Impatiens chikuensis* Kiew, sp. nov.

It is most similar to *Impatiens foxworthyi* M.R.Hend. in its ovate leaves with c. 3 pairs of ascending veins, in the erect racemose inflorescences held above the leaves with persistent, broadly ovate bracteoles, and in the flower with a short stout curved spur; but it is clearly different in its pale yellow or creamy yellow (vs bright canary-yellow) flowers that are more narrowly tubular, the petals are strongly reflexed with an undulate margin (vs the lower petals project forward and spread out and are neither reflexed, nor undulate), its spur is 11–14 mm long, more than half the length of the dorsal sepal (vs 6–11 mm long and about a third the length of the dorsal sepal) and, in addition, the teeth on the leaf margin are not tipped by a glandular hair as they are in *I. foxworthyi*. – TYPE: Peninsular Malaysia, Kelantan, Gua Musang District, FELDA Chiku 8, 1 September 2015, limestone hill, *Noor Neknazrul et al. FRI83182* (holotype KEP; isotypes BKF, K, SING). (Fig. 1–3)

Perennial, glabrous herb. **Stems** erect, succulent, not expanded at the base nor tuberous, sparsely branched, 15–20 cm tall, in life to 15 mm diam. at the base. **Leaves** spirally arranged, crowded on the upper part of the stem; petioles c. 8 cm long; lamina broadly ovate, 10–11 × 6–6.5 cm, base cuneate and shortly decurrent into the petiole, with 2 glands adjacent to the petiole, plain green above or sometimes with white veins, fleshy in life, membranous when dry, margin shallowly serrulate, without a glandular hair terminating the tooth, apex shortly acuminate or acute; lateral veins 3 on either side of the midrib, ascending and looping toward the margin; intercostal veins obscure. **Inflorescences** racemose, axillary or subterminal, erect and held above the leaves, 14–20.5 cm long, slender, simple or two-branched, many-flowered, peduncle slender, 3.5–6 cm long. Bract pair narrowly lanceolate, 10–12 × c. 2 mm long, persistent; bracteoles pale green, oval to broadly ovate, 3–5 × 3–3.5 mm, apex acuminate, persistent. **Flowers** pale yellow or cream-coloured with a few large scarlet spots on lower petal lobes; pedicels pale green, slender, 10–20 mm long; *lateral sepals* 4, *outer pair* broadly ovate-orbicular, shallowly cucullate, greenish white, 4.5–9 × 4.5–10 mm, apex apiculate, *inner pair* narrowly lanceolate, c. 2 mm long; *lower sepal* funnel-shaped, very pale yellow, 19–23 mm long, 7–17 mm deep, margin entire with a blunt mucro at the base, abruptly constricted into the stout *spur* 11–14 mm long, strongly curved towards the apex, apex blunt (not bilobed); *dorsal petal* creamy yellow, broadly



Fig. 1. *Impatiens chikuensis* Kiew. **A.** Plant *in situ*. **B.** Raceme with flower in front view. **C.** Raceme with flower in side view. From type locality. (Photos: P.T. Ong)

obovate, keel prominent at base, 6.5–8 × 5 mm, strongly reflexed, margin undulate, apex emarginate; *lateral petals* connate, 8–12 × 12–14 mm, split almost to the throat, strongly recurved, margin undulate, lobes almost equal, apex rounded; stamens white, c. 4–5 mm long; ovary narrowly obovoid, glabrous, c. 6 mm long, apex apiculate. **Capsules** narrowly obovoid, c. 13 mm long, 4.5–5 mm wide; pedicel 15–20 mm long.

Distribution. Endemic in Peninsular Malaysia. In Kelantan known only from the Chiku limestone, from two hills known as FELDA Chiku 5 and 8.

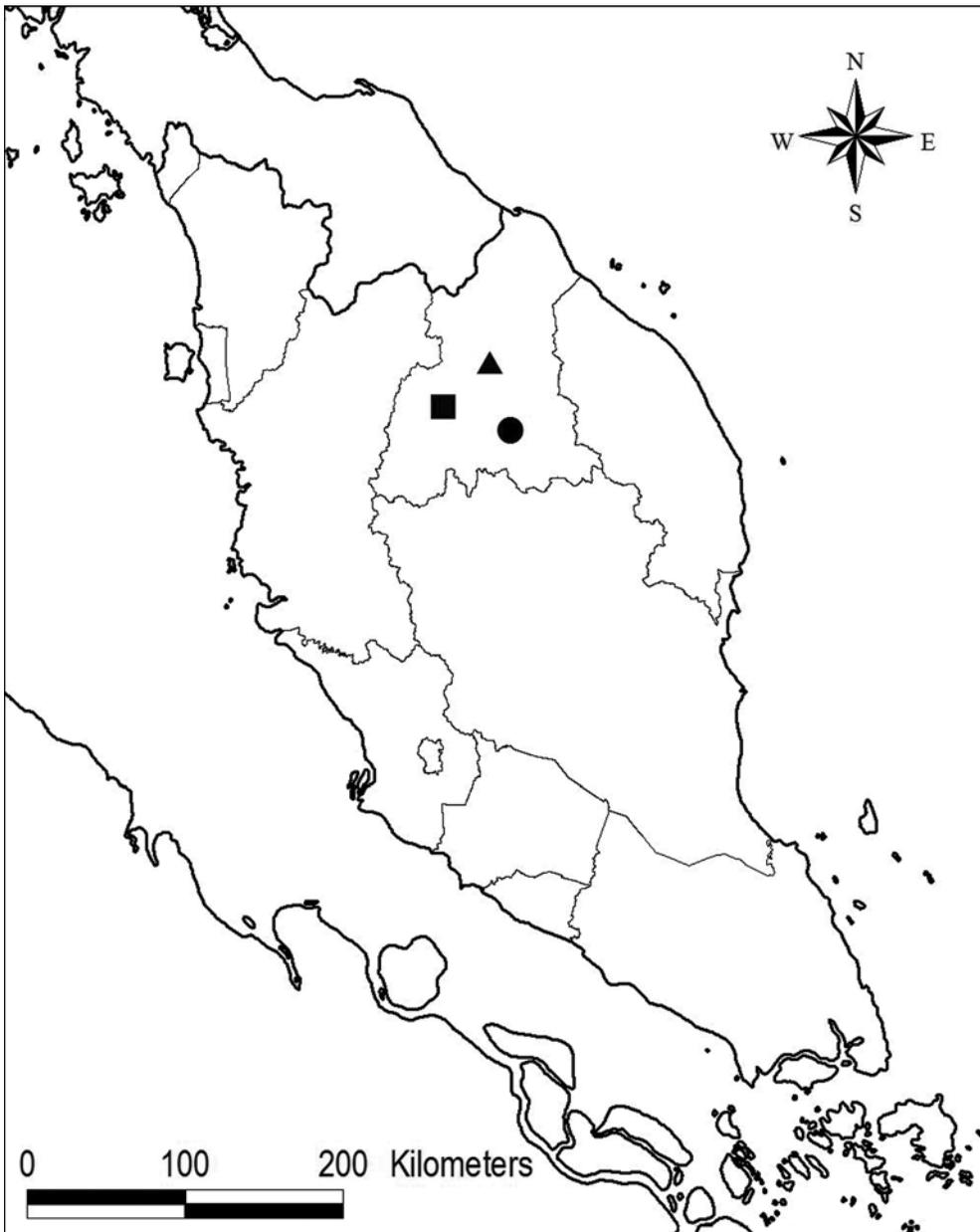


Fig. 2. Distribution of *Impatiens chikuensis* Kiew (●), *I. glaricola* Kiew (▲) and *I. vinosa* Kiew (■) in Peninsular Malaysia.

Habitat and ecology. On limestone rocks at the base of limestone karst hills in damp places in deep shade or in shaded gullies. It is nowhere common. It flowers gregariously from time to time but does not appear to flower seasonally. It has been observed in flower in January, May-June and August-September. It flowers for two to three weeks, the flowers opening one at a time, each lasting for a day or two.

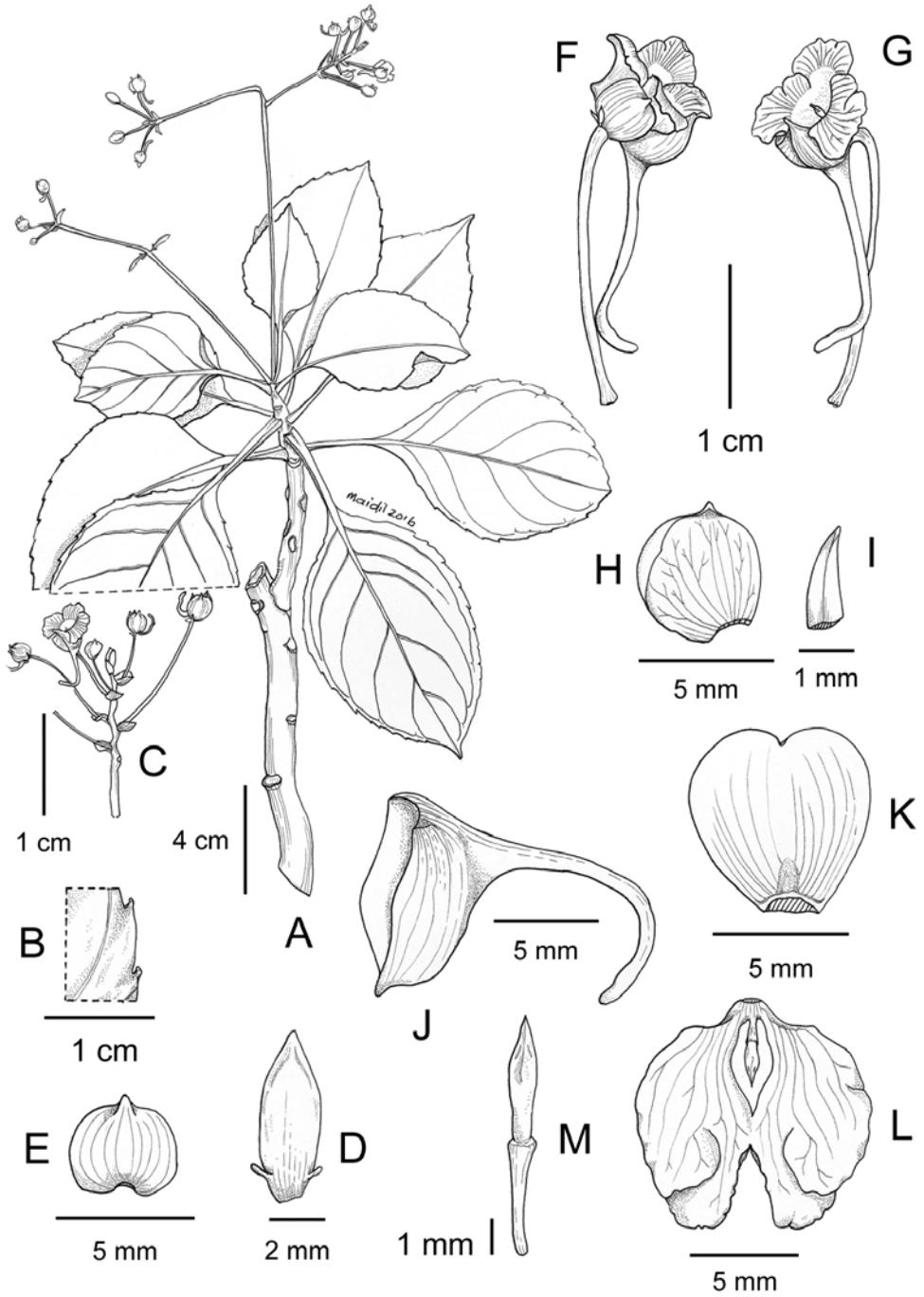


Fig. 3. *Impatiens chikuensis* Kiew. **A.** Habit. **B.** Portion of leaf margin. **C.** Portion of raceme; **D.** Bract. **E.** Bracteole. **F.** Flower, side view. **G.** Flower, oblique front view. **H.** Outer sepal. **I.** Inner sepal. **J.** Lower sepal. **K.** Dorsal petal. **L.** Connate lateral petals. **M.** Ovary. Drawn by Mohamad Aidil Noordin from live plant.

Provisional IUCN Conservation Assessment. Critically Endangered A3c, B2ab(iii, iv). Known only from the Chiku limestone, a series of small karst limestone hills that lie within the FELDA oil palm estate. It is nowhere common nor is it found on every hill. The Chiku 7 & 8 hills are currently scheduled for quarrying for cement that will eventually consume the two hills completely. The other smaller hill, Chiku 5, where it is found has no legal protection and is surrounded by oil palm estate and so is isolated from the other hills and vulnerable to fires associated with agriculture, and clearing of vegetation for various purposes.

Etymology. Named for the only locality from where it is known, viz. FELDA Chiku limestone.

Notes. This species was first reported in 1990 from Chiku 5 (Davison & Kiew, 1990).

2. *Impatiens foxworthyi* M.R.Hend., Gard. Bull. Straits Settlement. 4: 50 (1927); Henderson, J. Malayan Branch Roy. Asiat. Soc. 17: 38 (1939); Henderson, Malayan Nat. J. 3: 35 (1948). – TYPE: Peninsular Malaysia, Pahang, Gua [Goa] Kechapi, February 1924 *Md. Nur (with Foxworthy) SFN11912* (holotype SING). (Fig. 4)

Impatiens opinata auct. non Craib: Shimizu, S.E. Asian Stud. 8(2): 216 (1970); Chin, Gard. Bull. Singapore 32: 96 (1979); Kiew, Malayan Naturalist 38(3): 33 (1985); Kiew in Henderson's Malaysian Wild Fl. Dicot. 173 (2014).

Perennial, glabrous herb. **Stems** erect, succulent, in life to 10 mm thick, smooth (not corky), not expanded or thickened at the base, often becoming decumbent and rooting, branched but flowering when still unbranched, 10–35(–70) cm tall, with conspicuous leaf scars. **Leaves** spirally arranged, crowded at the top of the stem; petioles 2.3–9 cm long, petioles of the lower leaves longer than the upper, with a pair of glands adjacent to the petiole; lamina broadly ovate, sometimes to elliptic, 4.5–10(–15) × 3–7.5 cm, green above, often with a broad white band along the midrib and veins, whitish green beneath, succulent, base narrowed and decurrent into petiole, margin minutely dentate serrulate; apex shortly acuminate; lateral veins 3–4 on either side of midrib, ascending steeply and joining at the margin, plane above and beneath when dry. **Inflorescences** axillary or subterminal, racemose, erect and above the leaves, (5.5–)12–30 cm long, sometimes once branched, flowers numerous at the top of the raceme, opening one at a time, peduncle succulent, pedicels slender, 1.5–2 cm in flower, lengthening to 2–2.5 cm in fruit. Bracts conspicuous, ovate, 2–4 × 1.5–2.5 mm, persistent. **Flowers** canary yellow with deep crimson to purple-black spots scattered all over the petals or, in some populations, plain white or white speckled with red spots or pale pink; *lateral sepals* 4, pale green, *outer sepal pair* ovate-orbicular, 5–8 × 4–6 mm long, yellow tinged red, slightly keeled, keel green, apex with a thick blunt mucro, *inner sepal pair* narrowly linear, c. 4 mm long; *lower sepal* funnel-shaped, pale yellow, sometimes reddish, 7–18 mm deep with a short point below, 17–35 mm long of which the stout, incurved *spur*



Fig. 4. *Impatiens foxworthyi* M.R.Hend. **A.** White-veined form *in situ*. **B.** Raceme with flower in front view. **C.** Raceme with flower in side view. All from FRI20150275. (Photos: P.T. Ong)

is 6–11 mm long, apex obtuse; *dorsal petal* ovate, 7–8 mm long, 4 mm wide, the keel prominent at base; *lateral petals* connate, 10–15 mm long and 8 mm broad, sessile, four-lobed, the lobes rounded and nearly equal, spreading wide; filaments and anthers pale cream. **Capsules** obovoid, c. 12 mm long (?mature).

Distribution. Endemic in Peninsular Malaysia. In Kelantan it is common in the south but has not been found north of Sungai Nenggiri. In Pahang it is less common but is found on most limestone hills.

Habitat and Ecology. Restricted to limestone, always in shaded areas, on boulders around the base, or on ledges or in gullies, rooting in cracks with very little soil at 30–250 m elevation. On the Chiku limestone, this species was heavily grazed by serow, *Capricornis sumatraensis* (*pers. obs.*, R. Kiew in 1990 and 2015).

Provisional IUCN Conservation Assessment. Least Concern. It is a widespread species, often common where it occurs.

Etymology. F.W. Foxworthy (1877–1950), American forester and the first forest research officer (1918–1932) in Malaya.

Notes. Shimizu (1970) synonymised *Impatiens foxworthyi* with *I. opinata* on the grounds that “I have only a photo of the type specimen of *I. opinata*, its description agrees well with the specimens referred to as *I. foxworthyi*”. However, examination of a type specimen of *Impatiens opinata* (Kerr 7304, BK) shows that while it resembles *I. foxworthyi* in its ovate leaves, racemose inflorescences and yellow flowers, it is very different in its thick, corky stem and expanded bulbous base, larger leaves (to 16.5 × 10 cm) and shorter inflorescence (8–13 cm). Unfortunately, the state of preservation of the flowers on the BK duplicate prevented their examination but from Craib’s description the pedicel is much shorter (7 mm long), the spur much longer (13 mm long), the dorsal petal wider (7 × 7.75 mm) and the lateral sepal longer (2 cm). *Impatiens opinata* is a rare species in Thailand, known only from the type collection and one or two other specimens that possibly belong to this species. All have the thick corky stem. Plants of *Impatiens foxworthyi* have thick, succulent green stems that are quite smooth and the base is not expanded. Therefore the Malaysian species reverts to its original name, *Impatiens foxworthyi* M.R.Hend. It is noteworthy that *Impatiens foxworthyi* grows within the equatorial zone and does not extend into the north of Malaysia that borders Thailand that experiences a monsoon climate with a distinct dry period.

In most populations, the flower is canary yellow with deep crimson spots in the throat. However, the population on limestone in Taman Negara (Kiew, 1985) either has a plain white or pale pink flower, while scattered plants among populations of yellow-flowered *Impatiens foxworthyi* in Chiku 5 have white flowers speckled all over by tiny red spots.

Additional specimens examined. PENINSULAR MALAYSIA: **Kelantan:** Bukit Tapah, 16 Aug 1971, *Boey 350* (KLU); Chiku 5, 24 May 1990, *Kiew & Anthonysamy RK3106* (KEP); ibidem, 24 May 1990, *Kiew RK3095*; Chiku 8, 24 May 1990, *Kiew & Anthonysamy RK3110* (KEP); Gua Batu Boh, 4 Mar 2008, *Chew et al. FRI60155* (KEP); Gua Gagak, 21 May 1990, *Kiew & Anthonysamy RK3066* (KEP, SING); Gua Panjang, Gua Ninik, 22 Oct 1927, *Henderson SFN19558* (SING); Gua Pintu, 3 Nov 2008, *Chew & Lim FRI63402* (KEP, K); Gua Puyu, 11 Aug 2009, *Julius et al. FRI57654* (KEP, SAN); Gua Tapah, 16 Aug 1971, *Chin 1610* (KLU); Kuala Betis, 15 Feb 2003, *Kiew RK5255* (KEP, SING); Pulau Raba, 12 May 1990, *Kiew & Anthonysamy RK2912* (KEP, SING). **Pahang:** Bukit Sagu, 13 Oct 1931, *Henderson SFN26087* (SING); ibidem, 27 Nov 1984, *Kiew RK1574* (KEP, SING); ibidem, 5 May 2011, *Rafidah et al. FRI64645* (KEP); Gua Bama, 25 Aug 2008, *Mohd Hairul et al. FRI60065* (KEP); Gua Bekong, 5 Aug 1996, *Saw FRI44755* (KEP); Gua Kenyam, 2 Aug 1971, *Chin 1312* (KLU); Gua Kumbang, 29 Apr 1975, *Yap SK638* (KEP); Gua Layang, 13 Aug 1971, *Chin 1495* (KLU); ibidem, 18 Aug 1971, *Boey 303* (KLU); Gua Luas, 29 Sep 1982, *Kiew RK1200* (KEP, KLU); ibidem, 1 Oct 1984, *Kiew RK1350* (KEP); ibidem, 10 Feb 2007, *Lim et al., FRI56382* (KEP); Gua Percik, 3 Oct 2013, *Imin et al. FRI78237* (KEP); Gua Telok Gunung, 30 Sep 2013, *Imin et al. FRI77866* (KEP); Gua Ulu Rakit Gunung, 1 Oct 2013, *Imin et al. FRI77882* (KEP, SAN).

3. *Impatiens glaricola* Kiew, sp. nov.

Among the Malaysian balsams with solitary flowers with a short recurved spur, *Impatiens glaricola* differs from *I. macrosepala* Hook.f., which has white flowers with red markings (vs pale purple flower and pale yellow spur), 4 lateral sepals with the outer pair connate (vs 2 free lateral sepals), shorter lower sepal 12–18 mm and spur 8 mm long (lower sepal c. 33 mm long of which the spur is 16 mm long), and shorter pedicels to 1.5 cm long (vs to 4 cm long); and from *I. alboflava* Miq., which has broader leaves (3 times vs 2 times longer than wide) that dry pale yellowish brown (vs dark khaki brown), pale creamy white or white flowers red spotted in the throat (vs pale purple flower and pale yellow spur), 4 lateral sepals (vs 2 lateral sepals), and a shorter, 8–13 mm long straight spur (vs a curved spur c. 16 mm long). – TYPE: Peninsular Malaysia, Kelantan, Kuala Krai District, Gua Ikan, 14 May 1990, *Kiew & Anthonysamy RK2937* (holotype KEP; isotypes K, L, SING). (Fig. 2, 5)

Perennial, glabrous herb. **Stems** erect, succulent, smooth, 27–40(–100) cm tall, not expanded and to 2 cm thick at the base, unbranched or branching and producing a spreading crown, lateral branches to 10 cm long. **Leaves** spirally arranged, crowded near the tip of the branches; petioles succulent, 3–10 cm long; lamina elliptic to narrowly ovate, (9.5–)15–17 × 5.5–7 cm, pale green, membranous, drying tissue-paper thin, base cuneate to rounded, not attenuate into the petiole, sometimes unequal, with a pair of glands on lower surface adjacent to the petiole, margin finely dentate, apex acuminate, acumen to 1.5 cm long; midrib and veins impressed above, prominent beneath; lateral veins 9–16 on either side of the midrib, looping toward the margin. Bracts lanceolate, ovate, 2–3.5 mm long, persistent, apex acute. **Flowers** solitary, axillary, c. 1.5 cm across the mouth; pedicels to 4 cm long slender, pale brownish green; *lateral sepals* 2, free, pale green, broadly ovate, c. 12 × 7 mm long, apex acute

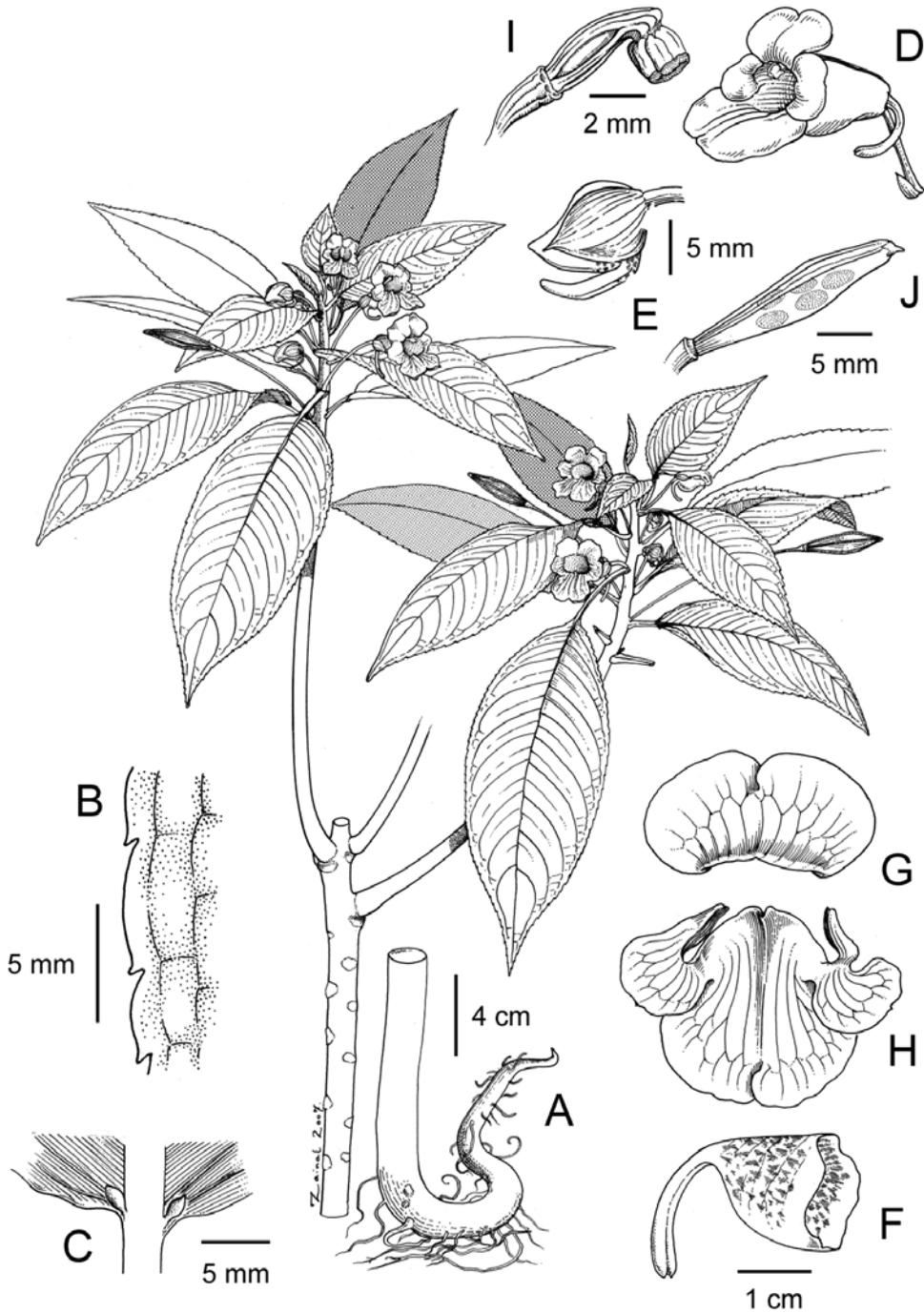


Fig. 5. *Impatiens glaricola* Kiew. **A.** Habit. **B.** Portion of the leaf margin. **C.** Pair of glands at base of lamina. **D.** Flower. **E.** Flower bud with outer sepals. **F.** Lower sepal. **G.** Dorsal petal. **H.** Connate lateral petals. **I.** Stamens. **J.** Ovary. Drawn by Zainal Mustapa from live plant.

to apiculate; *lower sepal* broad and funnel-shaped, c. 33 mm long, white merging into pale orange, c. 20 mm deep, abruptly constricted into a slender, downward curved, pale yellow *spur* c. 16 mm long, c. 3 mm wide, apex bilobed, notch 3 mm deep; *petals* pale grey-purple, lower petals with fine golden yellow lines running into the throat, throat speckled with crimson spots; *dorsal petal* broad, erect to slightly recurved, c. 10 × 22 mm, apex emarginate; *lateral petals* connate, upper petal of each pair broadly rounded, c. 8 × 13 mm, reflexed, lower petals connate and forming a broad oblong lip, c. 18 × 17 mm, projecting more-or-less horizontally, apex emarginate, shallowly lobed; ovary glabrous. **Capsules** narrowly ellipsoid, apex apiculate.

Distribution. Endemic in Peninsular Malaysia, known only from Gua Ikan, Kelantan.

Habitat and ecology. Restricted to damp limestone boulders forming a scree at the base of a limestone karst hill, in light or deep shade, locally common.

Provisional IUCN Conservation Assessment. Critically Endangered B2ab(iii, iv). It is known from a single karst limestone hill where it is restricted to a single scree slope of jumbled boulders. This is adjacent to the cave which is a popular recreational area so the balsam population is threatened by disturbance caused by recreational activities. The hill has no legal protection.

Etymology. Latin, *glara* = scree + *-icola* = dwelling, from its habitat.

Additional specimen examined. PENINSULAR MALAYSIA: **Kelantan:** Gua Ikan, 18 Feb 2003, Kiew RK5266 (K, KEP, L, SING).

Notes. This is one of the most attractive balsams in Peninsular Malaysia with its large purple flowers. In spite of the comprehensive survey of Kelantan limestone hills (Davison & Kiew, 1990), this species was not discovered on any other hill. Another purple-flowered balsam has been reported from northern Peninsular Malaysia by Morgan (2007) who provided photographs of its flowers and a brief description. In its small leaves, 5–6 × 3–5 cm, lower sepal that narrows into a short claw-like spur it is different from either *Impatiens alboflava*, *I. glaricola* or *I. macrosepala*, and is quite likely to prove to be a new species. At present no Malaysian material of this taxon is available.

Species with flowers with a short, recurved spur, such as *Impatiens alboflava*, which Shimizu (1970) referred to as *I. scortechini* Hook.f., and *I. macrosepala*, have four lateral sepals, an outer pair that encloses the lower sepal, and an inner pair that is inconspicuous, linear and a few millimeters long. In *Impatiens glaricola*, the inner pair is lacking.

4. *Impatiens vinosa* Kiew, **sp. nov.**

In its raceme, spirally arranged leaves and short spur strongly incurved at the tip,

it is similar to the yellow-flowered *Impatiens mirabilis* and *I. foxworthyi*. *Impatiens mirabilis*, the gouty balsam, has a massive enlarged tuberous base and a thick trunk-like stem to 2 m high. In habit, *Impatiens vinosa* is more like *I. foxworthyi* but differs in stouter stem which in life is 8–20 mm thick (vs 10 mm thick in *I. foxworthyi*) that becomes thickened at the base, broader lamina 7–9.5 cm wide (vs 3–7.5 cm wide), venation with 5–7 lateral veins on either side of the midrib with very fine parallel veins between (vs 3–4 veins and without any intervening fine veins), flowers deep ruby red or dark red wine-coloured (vs bright yellow with crimson spots), and spur 12–14 mm long (vs 6–11 mm long). – TYPE: Peninsular Malaysia, Kelantan, Gua Musang District, Sungai Nenggiri, Gua Jaya, 13 May 1990, Kiew & Anthonysamy RK2936 (holotype KEP; isotype SING). (Fig. 2, 6)

Robust perennial, glabrous herb. **Stems** 50–75 cm tall, sometimes once branched, erect or becoming decumbent, stout and succulent, to 2 cm thick, base becoming woody and up to 4 cm thick, not expanded at the base. **Leaves** spirally arranged, crowded near the top of the stem; petioles 6–9(–14) cm long, c. 3 mm thick; lamina fleshy, broadly ovate, 8–13.5 × 7–9.5 cm, plain bright green, midrib sometimes white, white beneath, base truncate to broadly rounded, shortly attenuate into the petiole, with a pair of glands on the lower surface adjacent to the petiole, margin distantly and minutely dentate; apex shortly acuminate, acumen 3–10 mm long; lateral veins 5–7 on either side of the midrib, in dry leaf plane above and slightly prominent beneath, between and parallel to the lateral veins an even finer vein that peters out before reaching the margin. **Inflorescences** racemose, axillary or subterminal, erect and held above the leaves, 19.5–22 cm long, not branched, many-flowered, peduncle ridged and 4-angled in cross section. Bract pair narrowly lanceolate, c. 5 × 1.5 mm, persistent; bracteoles broadly lanceolate, c. 3 × 2.5 mm, caducous. **Flowers** deep ruby red or dark red wine-coloured; pedicels slender, c. 15–30 mm long; *lateral sepals* 4, *outer sepal pair* deep crimson, tinged green or pale green, ovate-orbicular, 10–12 × 7–11.5 mm long, apex mucronate, *inner sepal pair* linear, c. 4 mm long; *lower sepal* funnel-shaped, reddish green or pale green tinged red, 18–35 mm long, 13–17 mm deep, margin entire, narrowing abruptly into the curved reddish brown or pale green or cream-coloured *spur* 10–14 mm long, 1–1.5 mm thick, apex obtuse (not bilobed); *petals* ruby red or dark red wine-coloured, throat greenish-yellow or cream-coloured with a few fine red lines and tiny spots, *dorsal petal* broadly ovate, c. 12 × 13 mm, deep crimson; *lateral petals* connate, c. 24 mm long, *upper petal pair* reflexed, broadly rounded and overlapping the lower petal, 7–9 × 11–12 mm, *lower petal pair* broadly oblong, 14–17 × 20–26 mm, apical notch c. 5 mm deep; stamens pale green, c. 7–8 mm long; ovary glabrous, narrowly ovoid, c. 6 mm long, apex acute. **Capsules** dark green with 4 white longitudinal lines, obovoid, c. 15 × 5–7 mm, apex apiculate, pedicel 20–23 mm long.

Distribution. Endemic in Peninsular Malaysia. In Kelantan, known only from Sungai Bring, and Gua Chawan and Gua Jaya above the Sungai Nenggiri.

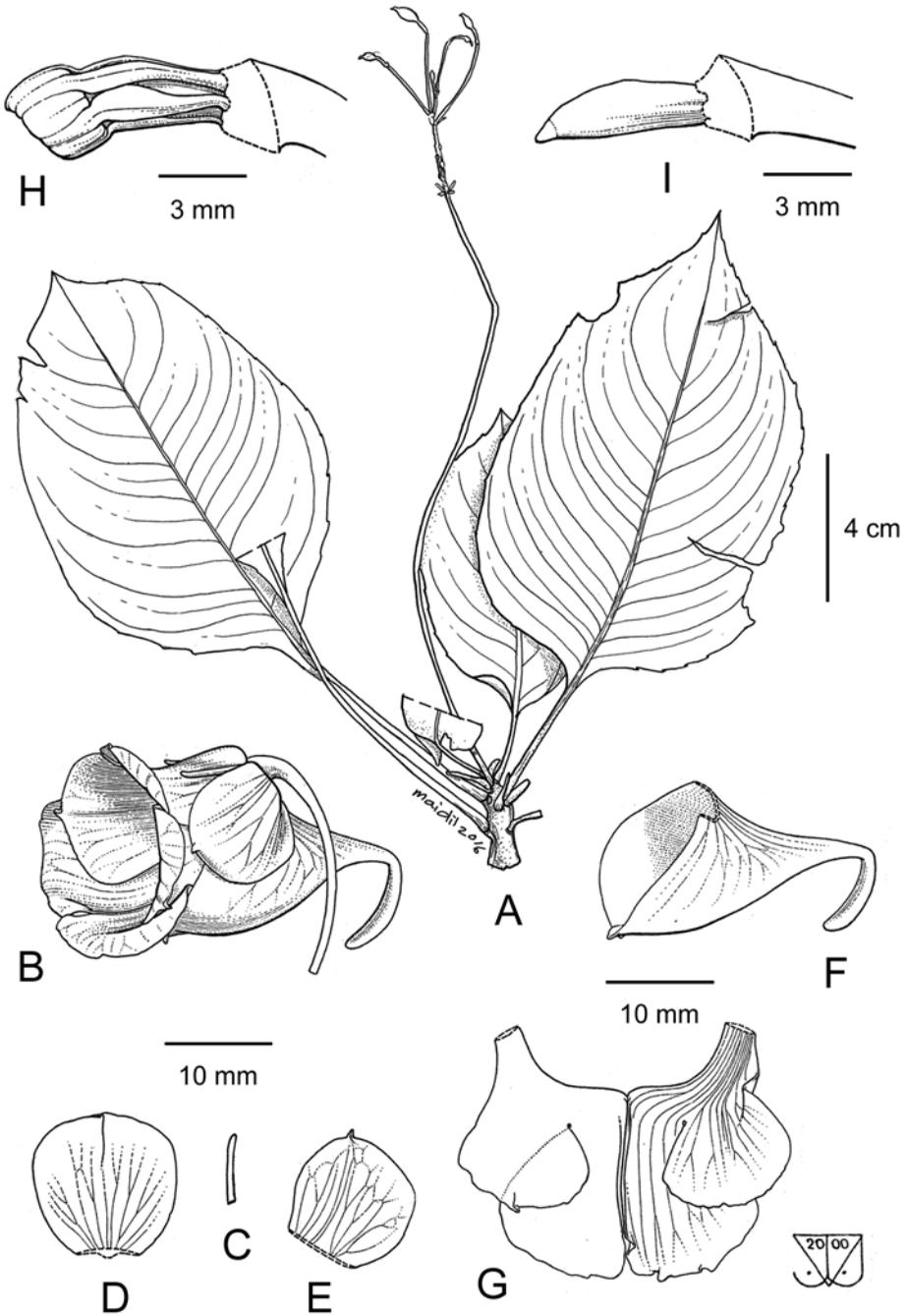


Fig. 6. *Impatiens vinosa* Kiew. **A.** Habit. **B.** Flower, side view. **C.** Inner sepal. **D.** Outer sepal. **E.** Dorsal petal. **F.** Lower sepal. **G.** Connate lateral petals. **H.** Stamens. **I.** Ovary. A & C from *FRI4245*, B, D–H from live plant. A & C drawn by Mohamad Aidil Noordin; B, D–H drawn by J.J. Vermeulen.

Habitat and ecology. Restricted to limestone karst hills, locally very common on jagged limestone, on shaded ledges on cliffs or on the flat top of boulders at the base of hills.

Provisional IUCN conservation assessment. Critically Endangered B2ab(iii). The Sungai Bring is threatened by siltation and flooding due to logging upstream and the forest surrounding the limestone hills does not fall within the network of Totally Protected Areas.

Etymology. Latin, *vinosa* = wine-red, referring to the flower colour.

Additional specimens examined. PENINSULAR MALAYSIA: **Kelantan:** Sungai Bring, 11 May 1990, Kiew & Anthonysamy RK2910 (KEP, SING); Sungai Nenggiri, Gua Jaya, 27 Jul 1967, Whitmore FRI4245 (KEP); Sungai Nenggiri, Gua Chawan, 13 Mar 2000, Kiew RK4913 (KEP, SING).

Notes. *Impatiens vinosa* is the only indigenous balsam in Peninsular Malaysia with deep wine-red flowers; all the others have pale purple, peachy orange, bright yellow or white ones.

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