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Two new species of *Pentaphragma* (Pentaphragmataceae) from Sarawak, Borneo

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ABSTRACT: Two new species of *Pentaphragma* (Pentaphragmataceae), *P. bicolor* and *P. pendula*, from Sarawak are described and illustrated. *Pentaphragma bicolor* resembles that of *P. prostratum* (Kiew, 1990) but is different in the stellate hairs (vs. glabrous) leaves, shorter petioles 0.5–2 cm long (vs 2.5–6(–13) cm long), erect (vs. deflexed) inflorescence with sessile or subsessile (vs. 10–15 mm long) peduncle and retuse (vs. apiculate) anther apices. *Pentaphragma pendula* is also similar to *P. longisepalum* (Kiew, 1990), but differs in its suborbicular (vs. elliptic) leaf shape, petioles to 3 (vs. to 9) cm long, inflorescence deflexed (vs. erect) with up to 12 flowers (vs. to 10 flowers), bracts to 3.5 × 1.5 cm (vs. 1–1.6 × 0.6–0.9 cm), corolla with recurved (vs. non-recurved) lobes.

KEY WORDS: Borneo, New species, Pentaphragmataceae, *Pentaphragma bicolor*, *Pentaphragma pendula*, Sarawak.

INTRODUCTION

Pentaphragma (with *ca.* 30 herbaceous species of south-eastern Asia, the Malay Archipelago and New Guinea) is the sole genus in Pentaphragmataceae (Lammers 2007), the genus is difficult for the herbarium taxonomist as a single herbarium specimen cannot fully represent the variations seen in populations in the field. For this reason, detailed field notes are particularly important (Kiew, 1990). For Sarawak, as part of an ongoing investigation of the genus in Borneo, Kiew (1990) has listed three new species in her final treatment of the genus *Pentaphragma* including two from Sarawak. The present study is based on specimens and living plants from private greenhouse collections in Hong Kong and Taiwan. A carefully studying of the literature and comparisons with the type specimen images of similar species supports recognition as two new species here.

TAXONOMIC TREATMENT

1. *Pentaphragma bicolor* C. W. Lin, ***sp. nov.***

- TYPE: MALAYSIA: Borneo, Sarawak, Sri Aman Division, Lubok Antu, Batang Ai, *ca.* 200 m elev. Type specimens pressed from plants cultivated in a private greenhouse in Hong Kong, 26 Apr. 2016, *C. W. Lin 632* (holotype: SAR; isotype: TAIF)

雙色五膜草 Figs. 1, 2; Tab. 1

Decumbent fleshy herb. **Stem** to 20 cm or longer, 0.4–0.7 cm in diameter, slightly woody towards the base, rooting at nodes, the distal portion of the stem shortly erect to 3–10 cm tall, scattered stellate-hairy becoming glabrescent. **Leaves** alternate, the basal ones nearly appressed to substrate, adaxially grey-green, usually with narrowly dark green zone along veins, abaxially pale green; broad-ovate to elliptic, 6–15×4.5–10 cm, apex acute or obtuse, base slightly unequal, rounded to truncate, sometimes cuneate, both surfaces with stellate hairs, especially densely hairy on veins of the abaxial surface; in fresh material succulent, drying chartaceous to thinly coriaceous, margin crenulate and lined with densely stellate hairs; secondary veins 3–5 on each side of midrib, looping slightly near the margin, adaxially slightly bullate between veins, all venation prominently raised abaxially. **Petiole** thick and fleshy in fresh material, in dried material 0.5–2 cm long, 2–4.5 mm in diameter, with dense stellate hairs. **Inflorescence** a sub-capitate condensed cyme, 1 or 2 from upper leaf axils, erect, each with 3–10 flowers. **Peduncle** sessile or subsessile. **Bracts** elliptic to ovate, 8–20 mm long, 3–7 mm wide, membranous in dried state, stellate-hairy on both surfaces, margin crenulate and lined with densely stellate hairs; bracteoles similar but smaller. **Flowers** subsessile, 1.8–3 cm long. **Calyx** lobes 5, pale green, oblong to ovate, 5–8 mm long, 1.2–5 mm wide, longer than the corolla lobes, margin stellate-hairy. **Corolla** golden yellow, becoming cream white to pale green with age, gamopetalous, densely stellate-hairy outside, tube 5–6 mm long, 4–5 mm in diameter, lobes 5, fleshy, ovate-triangular, 3–4 mm long, *ca*. 2.5 mm wide, apex acute and recurved, margin erose with stellate hairs. **Stamens** 5, filament *ca*. 1.5 mm long, anthers oblong to ovate, *ca.* 3 mm long, 2 mm wide, margin entire or slightly undulate, apex retuse to obtuse. **Hypanthium** narrowly subfusiform, 12–20×2–4 mm, shallowly ribbed, densely stellate-hairy outside. **Style** cylindric, 2.5–4.5 mm long, *ca*. 1 mm in diameter, stigma oblong to widely ovoid, fluted, 1.5–2 mm long, *ca*. 1.5 mm in diameter.

***Distribution and ecology*:** Endemic to Sri Aman Division (Batang Ai), Sarawak, Borneo (Fig. 5). Only known from valleys, and on steep slopes in lowland mixed dipterocarp forest, elevation 100–300 m.

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Table 1. Comparison of selected morphological characters of ***Pentaphragma bicolor***, ***P. pendula***, ***P. longisepalum*** and ***P. prostratum.***

Characters	*P. bicolor*	*P. pendula*	*P. longisepalum*	*P. prostratum*
Habit				
	Decumbent	Decumbent or climbing	Erect	Decumbent
Leaf				
shape	Elliptic towidely ovate or rounded	Suborbicular to very widely ovate	Elliptic	Ovate to widely ovate or elliptic
adaxial vestitute	Stellate hair	Glabrous	Glabrous	Glabrous
size (cm)	6–15 × 4.5–10	9–15 × 8–12	7.5–18.5 × 4–9	9–21 × 7–16
Petiole length (cm)	0.5–2	1.5–3	2–9	2.5–13
Bracts size (cm)	0.8–2 × 0.3–0.7	1.5–3.5 × *ca*. 1.5	0.7–1.6 × 0.3–0.9	1.2–2 × 0.35–6
Inflorescence				
flowers number	3–10	5–12	3–10	3–8
peduncle length	Sessile or subsessile	10–20 mm	7–12 mm	10–15 mm
peduncle	Erect	Deflexed	Erect	Deflexed
calyx lobes	Oblong	Oblong to narrowly ovate or spatulate	Lanceolate	Spathulate-ovate
corolla				
color	Golden yellow becoming cream white	Cream yellow to pale yellish green	White or whitish green becoming cream or yellow	Orange-yellow or deep yellow
lobes	recurved	recurved	non-recurved	non-recurved
anther				
shape	Widely oblong,	Ovate	Oblong	Oblong
apex	Retuse	Apiculate	Apiculate	Apiculate

Etymology: The specific epithet refers to the contrasting yellow and white color states of corolla.

Notes**:** *Pentaphragma bicolor* superficially resembles *P. prostratum* Kiew (1990: 552, Fig. 2) in the relatively smaller plant size and decumbent habit. However, *P. bicolor* differs in having leaves surface with stellate hairs, shorter petioles 0.5–2 cm long, erect inflorescences with sessile to subsessile peduncles, and retuse anther apices. A detailed comparison of the two species is presented in Table 1.

2. *Pentaphragma pendula* C. W. Lin, ***sp. nov.***

-TYPE: MALAYSIA: Borneo, Sarawak, Kuching Division, Serikin, *ca.* 100 m elev. Type specimens pressed from plants cultivated in a private greenhouse in Hong Kong, 6 Aug. 2015, *C. W. Lin 628*. (holotype: SAR; isotypes: TAIF).

垂花五膜草 Figs. 3, 4; Tab. 1

Low climbing or decumbent fleshy herb. **Stem** to 15 cm or longer, 0.4–1 cm in diameter, rooting at nodes and climbing vertically up soil steep slope, sometimes the distal portion of stem shortly erect, scattered sparsely stellate-hairy becoming glabrescent. **Leaves** alternate, congested, held slightly upwards or the basal ones nearly appressed to substrate, adaxially glossy, dark green with a silvery margin, abaxially pale green; suborbicular to broad-ovate, 9–15 × 8–12 cm, apex rounded or obtuse, base slightly unequal, rounded to obtuse, sometimes cuneate, adaxially glabrous, abaxially densely stellate hairs on the veins; in fresh material succulent, drying chartaceous, margin crenulate and lined with stellate hairs; secondary veins 3–5 veins on each side of midrib, looping slightly near the margin; adaxially venation impressed, strongly bullate between veins, giving lamina a rugose appearance; all venation prominently raised abaxially. **Petiole** thick and fleshy in fresh material, in dried material 1.5–3 cm long, 5–7 mm in diameter, with sparse stellate hairs. **Inflorescence** a sub-capitate or congested scorpioid, 1 to 3 from upper leaf axils, deflexed, each with 5–12 flowers. **Peduncle** 1–2 cm, sparse stellate-hairy. **Bracts** elliptic to ovate, 1.5–3.5 cm long, *ca*. 1.5 cm wide, membranous in dried state, glabrous or very sparsely stellate hairs, margin crenulate and lined with stellate hairs; bracteoles similar but smaller. **Flowers** pedicel to 5 mm long, flower 2.3–3.8 cm long. **Calyx** lobes 5, pale green, oblong to narrowly ovate or spatulate, 7–15 mm long, 1.5–7 mm wide, longer than the corolla lobes, margin with stellate hairs. **Corolla** cream yellow to pale yellowish-green, gamopetalous, sparsely to densely stellate-hairy outside, tube 6–9 mm long, 4–5 mm in diameter, lobes 5, fleshy, ovate-triangular, *ca*. 5 mm long, 2–3 mm wide, apex acute and recurved, margin erose with stellate hairs. **Stamens** 5, filament *ca*. 2 mm long, anther ovate, *ca*. 3 mm long, 1.5 mm wide, apiculate or elongated half-upper, sometimes retuse. **Hypanthium** narrowly subfusiform, 18–23 × 3.5–5 mm, shallowly ribbed, sparsely stellate-hairy outside. **Style** cylindric, 2–3 mm long, *ca*. 1 mm in diameter, stigma oblong to widely ovate, fluted, 2.5–3 mm long, *ca*. 1.5 mm in diameter.

Distribution and ecology**:** Endemic to Kuching Division (Serikin), Sarawak, Borneo (Fig. 5). On riverbank and at the base of limestone hills in light shade in lowland mixed dipterocarp forest, elevation *ca*. 100 m.

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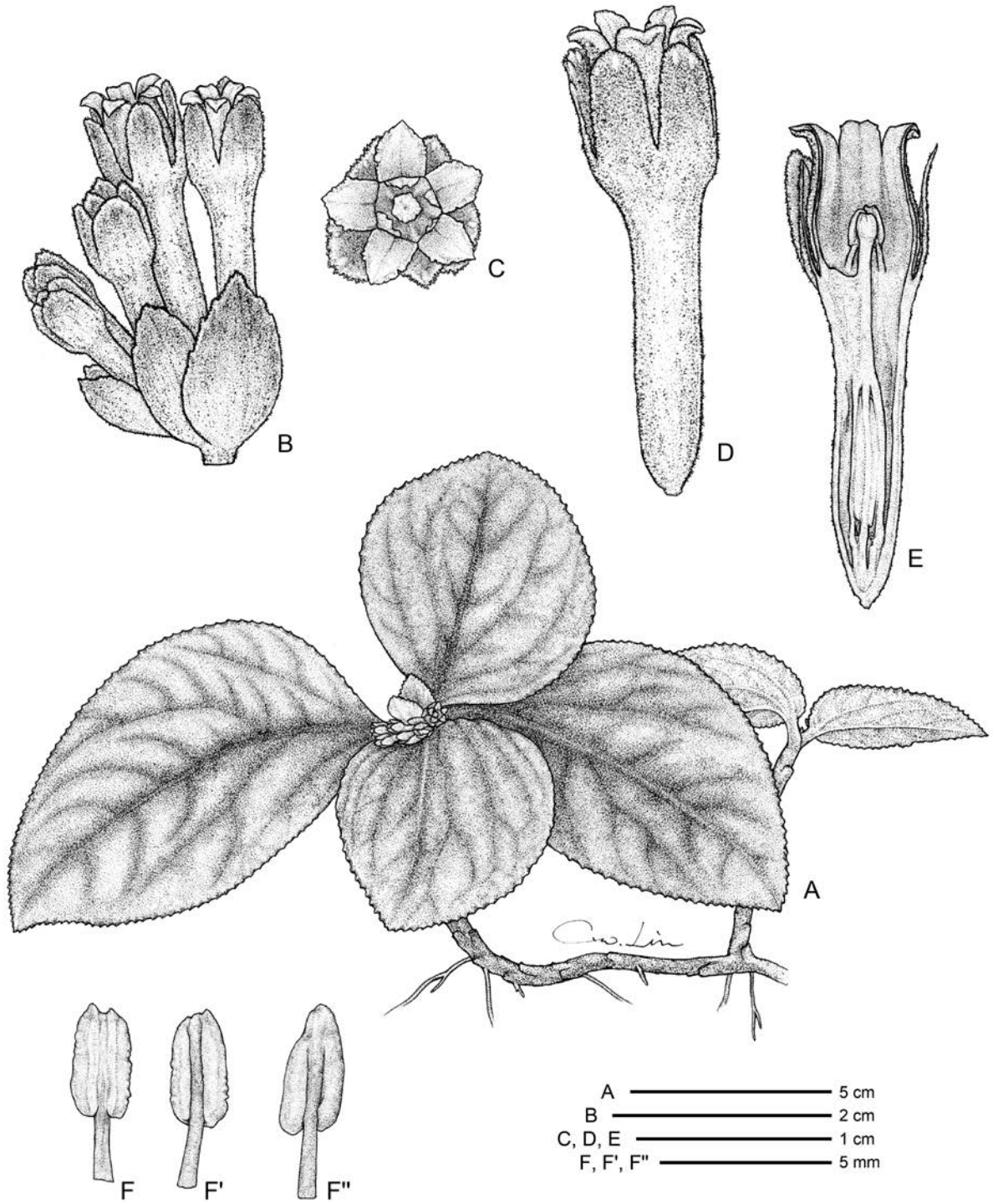


Fig. 1. ***Pentaphragma bicolor*** C. W. Lin **A**. Habit; **B**. Inflorescence; **C**. flower, face view; **D**. Flower, side view; **E**. section of flower; **F**, **F'**, **F"**. Stamens, ventrical and dorsal views. All from *C.W. Lin* 632 (TAIF).

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Fig. 2. ***Pentaphragma bicolor*** C. W. Lin **A**. Habit and habitat; **B**. Portion of leaf adaxial surface; **C**. Portion of leaf abaxial surface; **D**. Flowers; **E**. Inflorescence; **F**. Flowers, side view and showing the section of flower. **B–F** from *C.W. Lin* 632 (TAIF).

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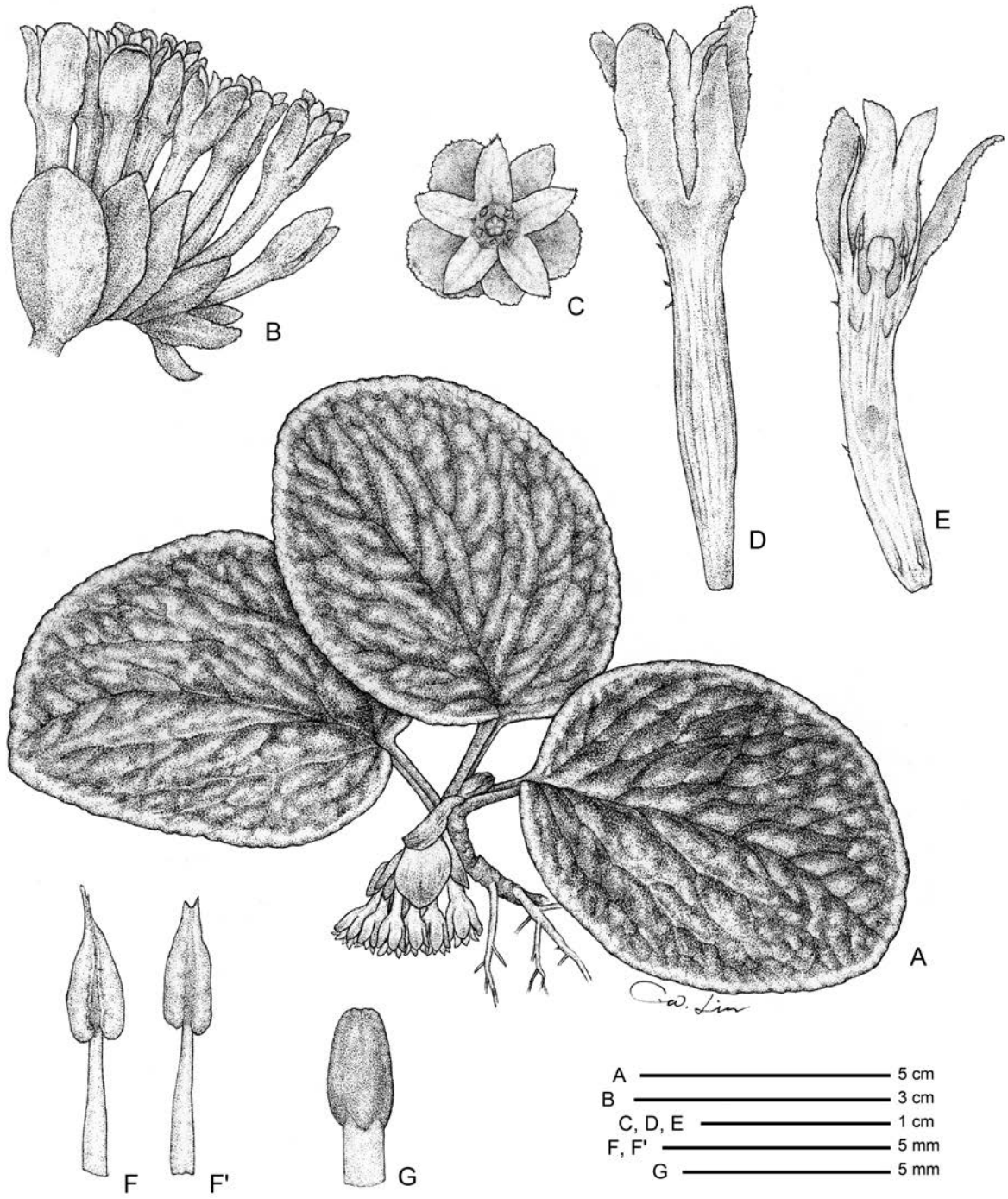


Fig. 3. ***Pentaphragma pendula*** C. W. Lin **A**. Habit; **B**. Inflorescence; **C**. flower, face view; **D**. Flower, side view; **E**. section of flower; **F**, **F'**. Stamens, ventrical and dorsal views; G. Style. All from *C.W. Lin* 628 (TAIF).

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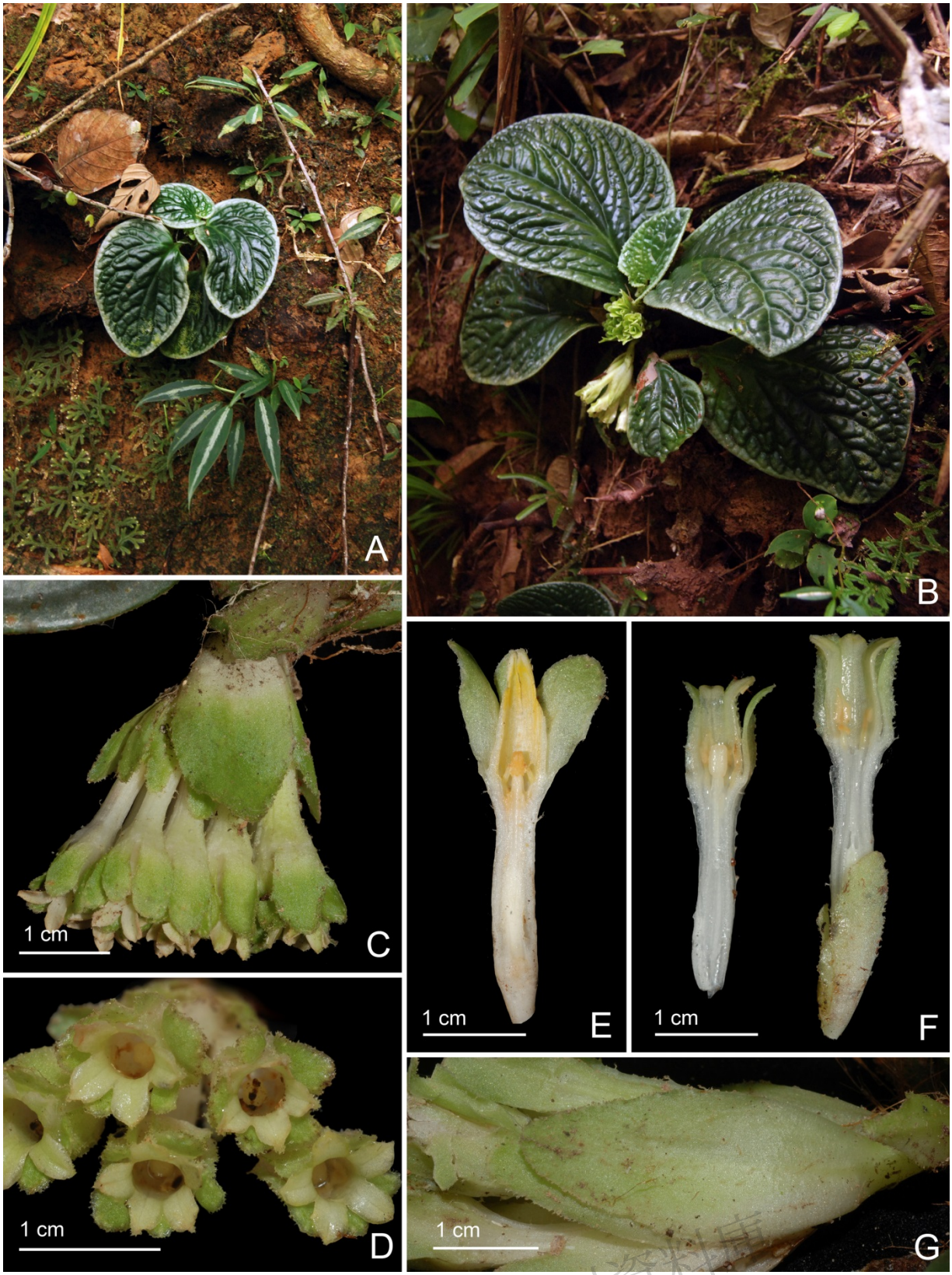


Fig. 4. ***Pentaphragma pendula*** C. W. Lin **A, B**. Habit and habitats; **C, D**. Inflorescence, side and face views; **E**. Section of an immature flower; **F**. Section of flowers; **G**. Bracts. **C–G** from *C.W. Lin* 628 (TAIF).

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Etymology: The specific epithet refers to the inflorescence that hangs down.

Notes**:** *Pentaphragma pendula* is somewhat similar to *P. obtusifolium* Merr. in having short-petiolate leaves and short deflexed inflorescences. However, *B. pendula* differs in having suborbicular (vs. elliptic-ovate) leaves, bracts to 1.5–3.5 × 1.5 (vs. 1.3 × 0.6) cm, bracts and sepals glabrous or very sparsely (vs. with thinckly) stellate-hairy outside. Geographically, *P. pendula* is endemic to lowland mixed dipterocarp forest in Serikin, Kuching Division, whereas *P. obtusifolium* is known only from montane forest in Mount Murud, Limbang Division (Fig. 5). The new species also resembles *P. longisepalum* Kiew (1990: 550, Fig. 2) in the smallish leaves and short inflorescence peduncles, but differs in suborbicular lamina, shorter petiole to 3 cm, each inflorescence deflexed with more flowers, larger bracts and recurved lobes. A comparison of *P. pendula* and *P. longisepalum* is presented in Table 1.

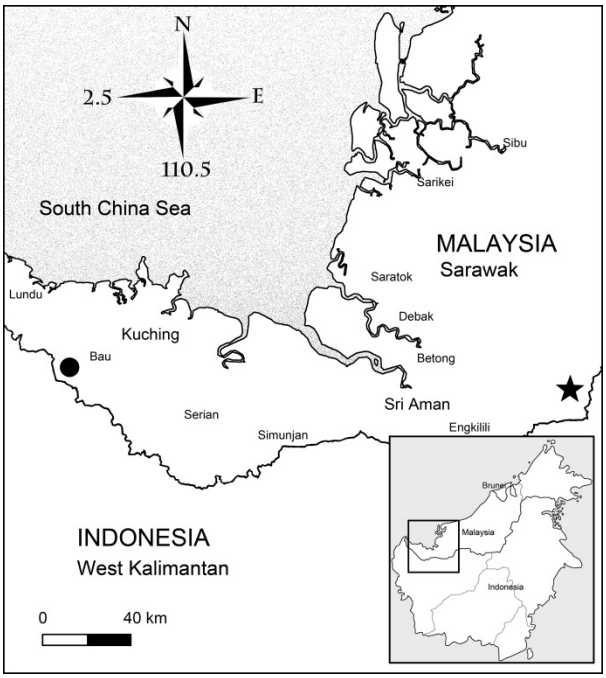


Fig. 5. Distribution map of ***Pentaphragma bicolor*** (star) and ***P. pendula*** (solid circle) in Sarawak, Borneo.

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