



## Four new species of *Scaphochlamys* (Zingiberaceae) from Peninsular Malaysia

YEN YEN SAM<sup>\*1</sup>, HALIJAH IBRAHIM<sup>2</sup> & LENG GUAN SAW<sup>1</sup>

<sup>1</sup>Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia

<sup>2</sup>Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

\*Corresponding author: [samyen@frim.gov.my](mailto:samyen@frim.gov.my)

### Abstract

Four new species of *Scaphochlamys* are described and illustrated, including preliminary conservation assessments. All the new species are endemic in Peninsular Malaysia.

**Key words:** endemism, ginger, taxonomy, Zingibereae, Zingiberales

### Introduction

*Scaphochlamys* Baker (1892: 252) is a genus of small gingers distributed from Peninsular Thailand, through Peninsular Malaysia to Borneo and Sumatra. Currently, there are 35 species described and nearly 66% (23 species) are found in Peninsular Malaysia (Sam *et al.* 2010, Searle 2010, Meekiong *et al.* 2011). All the Peninsular Malaysian species are endemic, except for two that are also found in Thailand's southernmost provinces bordering Peninsular Malaysia. Southern Thailand has 5 species of which 3 are endemic while Borneo has 9 species and all are endemic, and Sumatra has 1 endemic undescribed.

The taxonomy of *Scaphochlamys* is extremely challenging because the genus is highly polymorphic (Holtum 1950, Larsen 1962, Smith 1987). There are many local species confined to a small area in the evergreen rainforest of the West Malesia. The current study on *Scaphochlamys* by the first author discovered that these areas of high diversity and endemism are closely associated with the sites of rain forest refugia in the geological past (Morley, 2000; Quek *et al.* 2007; Tnah *et al.*, 2013).

Holtum's comprehensive revision of the genus for Peninsular Malaysia recognised 19 species including 8 new ones, and he cautioned to expect many new taxa. Since then, a total of 17 species have been discovered across its distribution range: 3 from Peninsular Thailand, 5 from Peninsular Malaysia and 9 from Borneo; and one species, *S. longifolia* Holtum (1950: 91), was synonymised (Smith 1987, Sirirugsa & Larsen 1991, Jenjittikul & Larsen 2002, Poulsen & Searle 2005, Sam & Saw 2005, Sam *et al.* 2010, Meekiong *et al.* 2011). Meanwhile, extensive field collecting to remote and under-collected sites continues to uncover new taxa. Four are described here as new species.

### Taxonomy

#### 1. *Scaphochlamys baukensis* Y.Y. Sam, *sp. nov.* (Figs. 1–2)

*Scaphochlamys baukensis* is different from all other species of *Scaphochlamys* in its broad obovate leaves, small compact rachis and tiny flowers.

**Type:**—PENINSULAR MALAYSIA. Terengganu: Bukit Bauk Forest Reserve, Endemic Trail, 93 m, 13 July 2007, Y.Y. Sam FRI 68955 (holotype: KEP!, isotypes: AAU!, E!, KLU!, SAN!, SING!).

Rhizomatous herb, 30–40 cm tall. Rhizome 4–5 mm diameter, light brown internally, running horizontally on ground surface, covered by thick leaf litter. Successive shoots emerging from rhizome, 2.5–13.5 cm apart. Bladeless

sheathes 2, the largest 5–6.5 cm long, hairy, dark purple brown, not persistent. Leaf 1 per shoot; sheath 1–1.5 cm long, membranous, very narrow, densely hairy, not persistent; petiole plus leaf sheath 6.5–11(19) cm long, channelled, densely covered with woolly hairs, base slightly swollen, whitish or tinged purple; lamina 17.5–20.5(–25) × 10–11.3(–12.1) cm, obovate, coriaceous, held sub-erect, base long attenuate, apex rounded, adaxial surface dark green and glabrous, abaxial surface pale green and hairy, tip usually tinged purple. Inflorescence 7.5–10 cm long; peduncle 4.5–6.5 cm long; rachis (2.5)3.2–4.1 × (1–1.6)2–2.5 cm, compact, composed of (5–6)12–16 floral bracts, spirally arranged, closely overlapping. Floral bract 20–24 × 13–15 mm, boat-shaped, light green, some with purple tinge at base, sparsely hairy, more dense at the tip, margin crisped, lower half of the margin slightly inflexed but not overlapping, apex acute, open and slightly recurved. Cincinnus with at least 7 flowers in the axil of each bract. First bracteole 18–20 mm long, shorter than bract, margin involute and overlapped, 2-keeled, hairy, apex acute; subsequent bracteoles reducing in size. Flowers ca. 33 mm long, white except labellum. Calyx ca. 7 mm long, tubular, unilaterally split ca. 4 mm from apex, apex incised, glabrous except the apex. Corolla tube ca. 21 mm long; corolla lobes 7–8 × ca. 3 mm, near triangular when flattened, apex acute, margin incurved. Staminodes ca. 3.5 × 1 mm, half the length of corolla lobes, linear, apex obtuse, covered by glandular hairs on adaxial surface. Labellum ca. 10 × 8 mm, obovate, apex bilobed, cleft 2 mm from apex, covered by glandular hairs on adaxial surface, white with yellow median band and red streaks on both sides. Stamen ca. 7 mm long; covered by glandular hairs on abaxial surface; filament ca. 2 mm long, tinged red; pollen sacs ca. 4 mm long, basal spurred, dehiscing longitudinally; anther crest ca. 1 × 1 mm, extended but not recurved, trilobed, midlobe pointed. Stigma less than 0.5 mm long, funnel-shaped, hairy. Ovary ca. 2 × 1 mm, covered by long fine hairs, unilocular with 2 ovules. Epigynous glands filiform, two, ca. 4 mm long.

**Etymology:**—The epithet refers to the location where the species is found.

**Distribution and ecology:**—Endemic in Peninsular Malaysia, so far known only from one location: Bukit Bauk Forest Reserve, Terengganu. It occurs in lowland dipterocarp forest, 93–135 m elevation, on forest floor near streams, level terrain, under small canopy gaps with sparse ground vegetation.

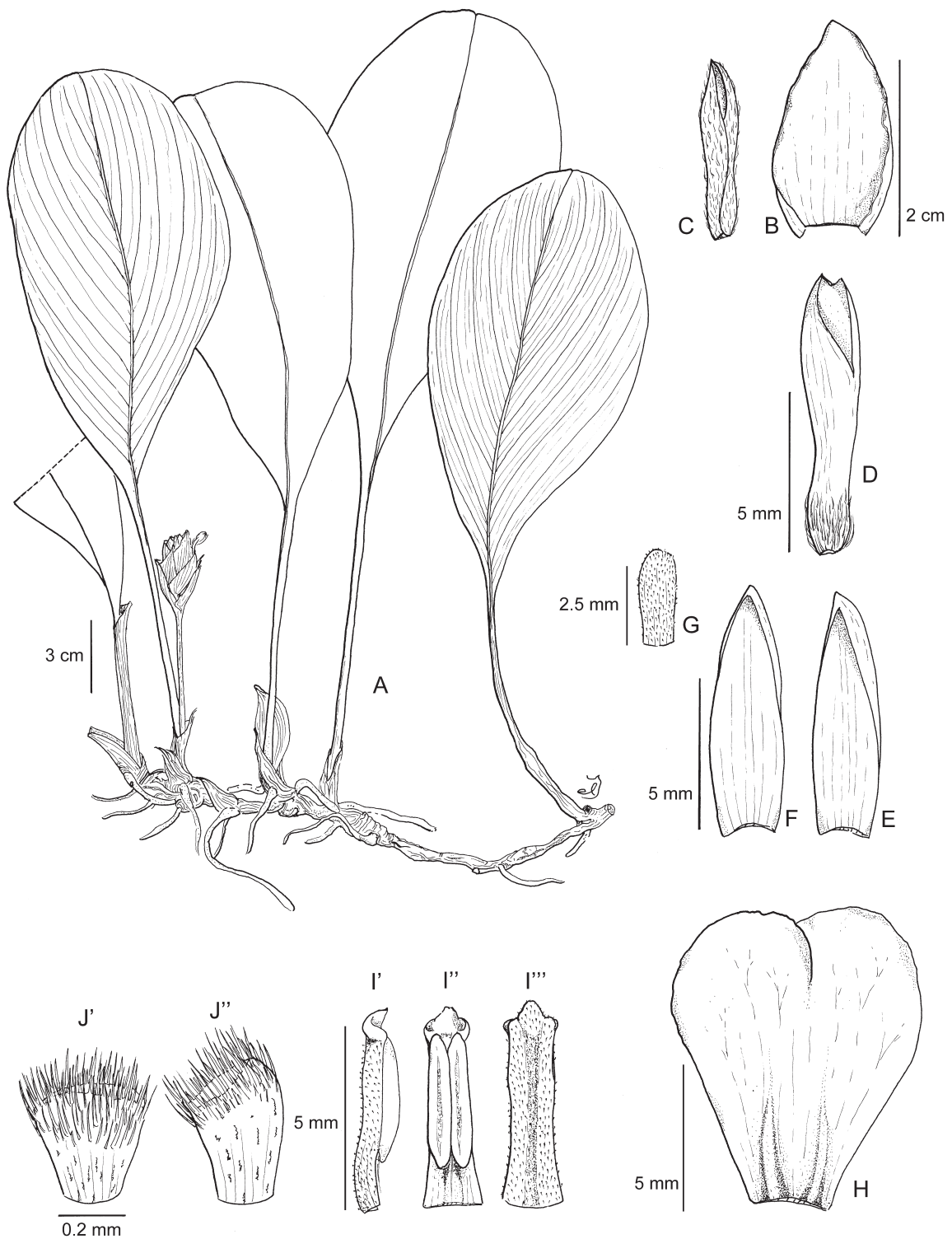
**Conservation status:**—Critically Endangered, CR B2ab(iii). The area of occupancy for *S. baukensis* is 4 km<sup>2</sup> and it is only known from one location, Bukit Bauk Forest Reserve. As a result, these criteria qualify the species to be listed under the CR category (IUCN 2012). Furthermore, the population on forest trail called “Endemic Trail” is threatened by disturbance because the site is a favourite recreation spot for local people. The clearing of undergrowth is a common practice in most recreation areas. Another population that is near to the road leading to the telecommunication tower on the summit is small and scattered. The possible disturbance is due to the clearing of an adjacent compartment of the forest reserve for the construction of a school that caused deterioration in the forest condition where the plants were found.

**Additional specimen examined (paratype):**—PENINSULAR MALAYSIA. Terengganu: Bukit Bauk Forest Reserve, road leading to the telecommunication tower, 135 m, 19 October 2002, *Y.Y. Sam FRI 47168* (KEP!).

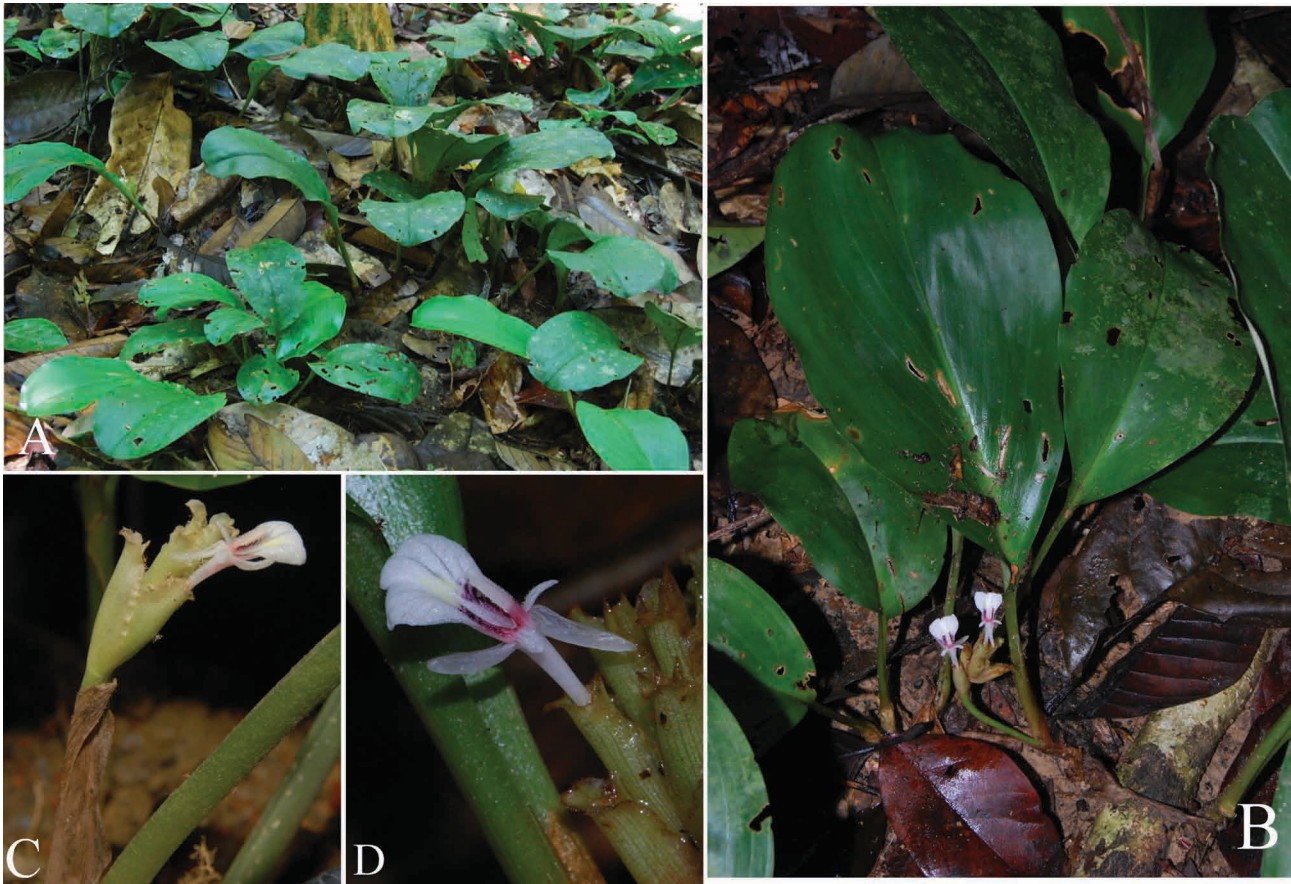
**Discussion:**—*Scaphochlamys baukensis* is unique in the genus. Its broad obovate leaves, compact rachis and tiny flowers easily distinguish it from other species. Other species with such dainty flowers and small, compact rachis are *S. pennipicta* Holttum (1950: 93), *S. petiolata* Smith (1987: 210), *S. pusilla* Sam (2010: 675) and *S. reticosa* Smith (1987: 209). Both *S. petiolata* and *S. reticosa* are endemic in Bornean Sarawak whereas *S. pennipicta* and *S. pusilla* are from Peninsular Malaysia. Besides broadly obovate lamina and crisped floral bracts, there are other morphological differences that separate *S. baukensis* from its similar looking taxa. For example, both *S. petiolata* and *S. reticosa* have scarious floral bracts and light purple labellum as opposed to the coriaceous bracts and white labellum in *S. baukensis*. *Scaphochlamys baukensis* has red streaks beside the yellow median band on its labellum but there is no such variegation on the labellum of *S. petiolata* and *S. reticosa*.

For *S. pennipicta*, it has distinct leaf variegation and floral bract texture readily distinguishable from *S. baukensis*. Its lamina upper surface has 2 white bands while the underneath is coloured entirely red that persisted with age. In *S. baukensis*, there is no such variegation on the lamina upper surface and only a slight red tinge on the lamina lower surface that disappears with age. Furthermore, the coriaceous floral bracts, yellow median band and red streaks on the labellum of *S. baukensis* differ from the thin bracts and completely white flowers of *S. pennipicta*.

At first glance, the small sized *S. baukensis* resembled *S. pusilla* from which it differs in the lamina shape. Closer examination of the inflorescence revealed many differences, especially in the floral characters. The floral bracts of *S. baukensis* is much larger than *S. pusilla* (20–24 × 13–15 versus 12–19 × 5–9 mm) and the cincinnus within consists of only 1–2 flowers compared to *S. pusilla* which has at least 7 flowers in each cincinnus. Two other distinct characters to separate *S. baukensis* from *S. pusilla* are the size of staminodes and the structure of stigma. The length of the staminodes of *S. baukensis* is only half of its corolla lobes whereas the size of staminodes and corolla lobes of *S. pusilla* is similar. *Scaphochlamys baukensis* has a funnel-shaped and densely hairy stigma whilst *S. pusilla* has a beak-like and ciliated stigma.



**FIGURE 1.** *Scaphochlamys baukensis*. A. Habit. B. Floral bract. C. First bracteole. D. Ovary and calyx. E. Dorsal corolla lobe. F. Lateral corolla lobe. G. Staminode. H. Labellum. I. Stamen side view (I'), front view (I''), back view (I'''). J. Stigma front view (J'), side view (J''). A–J from Y.Y. Sam FRI 68955 (KEP).



**FIGURE 2.** *Scaphochlamys baukensis*. **A.** Plants in loose clumps. **B.** Habit. **C.** Inflorescence. **D.** Flower. Photos by Y.Y. Sam.

**2. *Scaphochlamys endauensis*** Y. Y. Sam & H. Ibrahim, *sp. nov.* (Figs. 3–4)

*Scaphochlamys endauensis* resembles *S. breviscapa* but it differs in having a channelled petiole compared to the terete petiole in *S. breviscapa*. It also has a shorter bladeless sheath than *S. breviscapa* (6.5–10.5 cm versus 11.5–18 cm long).

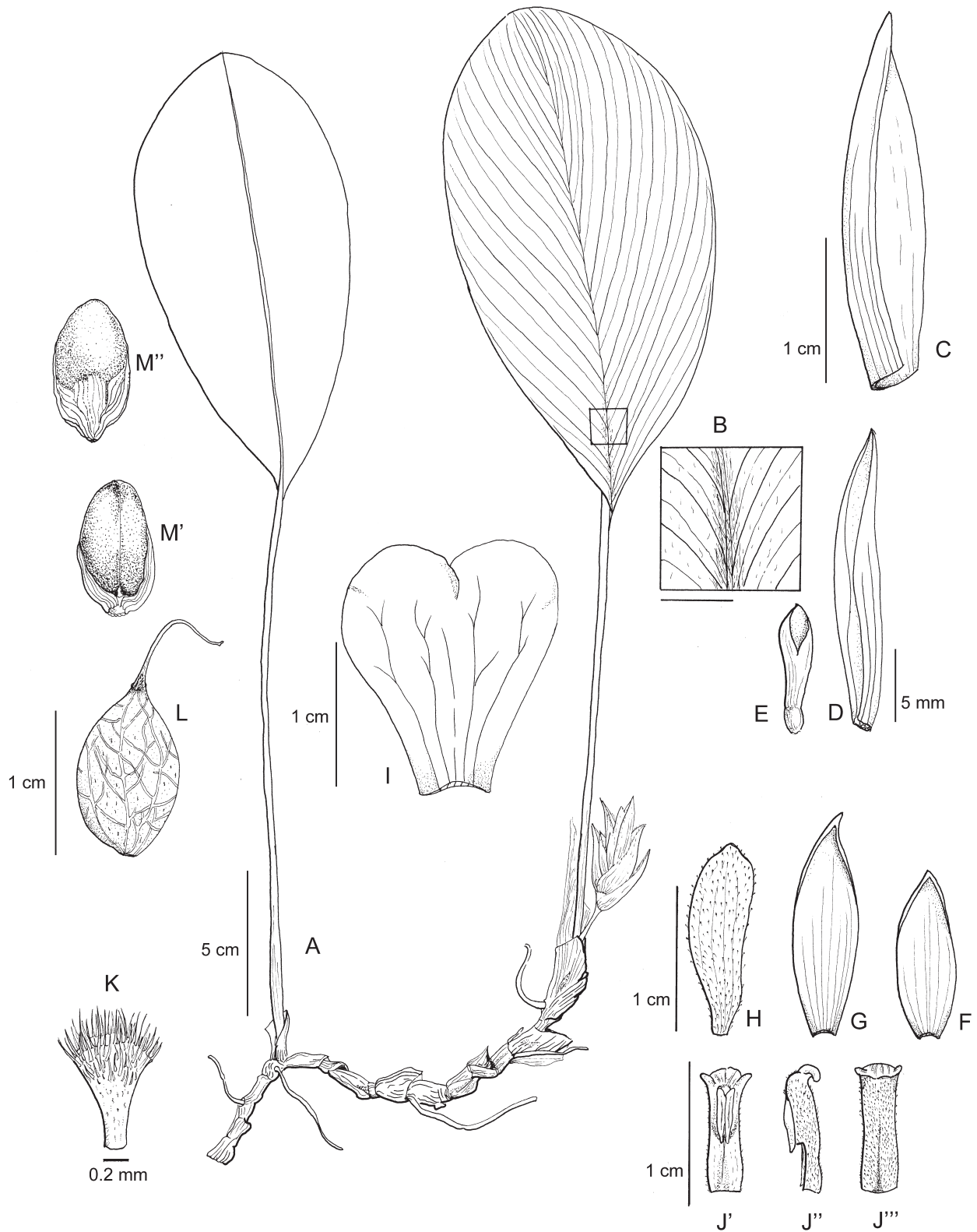
**Type:**—PENINSULAR MALAYSIA. Johor: Endau Rompin State Park, Kuala Jasin, trail to Gunung Janing Barat, 30–60 m, 9 August 2006, Y.Y. Sam, K. Apok & H.L. Kueh FRI 50204 (holotype: KEP!, isotypes: KLU!, SAN!, SING!).

Rhizomatous herb, (20–)30–50(–70) cm tall. Rhizome 3–5 mm diameter when dried, creeping horizontally on or below ground surface. Successive shoots clustering together and forming loose clump of 1–3 leafy shoots. Bladeless sheathes 2–3, the largest 6.5–10.5 cm long, dark purple red or green, hairy, not persistent. Leaf 1 per shoot, base slightly swollen; sheath 1.5–1.8 cm long, edges thin, hairy or glabrous, not persistent; ligule small, densely hairy; petiole plus sheath 10–36 cm long, channelled, dark purple red or green, glabrous or hairy; lamina 15–26.5(–33) × 7.3–12 cm, narrowly elliptic to oblanceolate, base cuneate to attenuate, apex broadly acute to obtuse, adaxial surface glabrous, abaxial surface glabrous or sparsely hairy, densely hairy along midrib, hairs fine, long and appressed, pale green with reddish tinge on apex. Inflorescence 4.5–16.5(–19) cm long, green or red; peduncle 1–10(–12.5) cm long, hairy; rachis 2–7.5 cm long, compact, axis not visible, consisted of (4)6–13 floral bracts, bracts overlapping and closely appressed to axis. Largest floral bract (23–26)30–35 × 11–13 mm, boat-shaped, dark purple red or green, sparsely hairy, more dense along the edges and apex, thick fleshy, margin incurved but not overlapped, apex acute, pointed upright. Cincinnus with (3)4–7 flowers in each bract. First bracteole 12–21 mm long, narrow, 8–10 mm width when flattened, 2-keeled, hairy or sparsely hairy on upper half, apex acute or blunt; subsequent bracteoles reducing in size. Flowers (40)46–55 mm long, white, except labellum. Calyx 8–12 mm long, ca. 2 mm width, tubular, hairy, split 3–5 mm unilaterally from apex, apex truncate or acute. Floral tube 28–32 mm long; dorsal corolla lobe 11–15 mm long, near triangular, edges inflexed, apex hooded, tip pointed; lateral corolla lobes 10–14 mm, edges inflexed, apex acute. Staminodes 8–12 × 3–5 mm, oblanceolate, apex broadly acute or near rounded, abaxial surface covered by glandular hairs. Labellum 13–20 ×

10–17 mm, obovate, apex bilobed, cleft 3–5 mm from apex, abaxial surface covered by glandular hairs, yellow median band with or without purple streaks at both sides. Stamen 6–9 mm long, covered by glandular hairs on abaxial surface; filament 2–4 mm long; pollen sacs 3–3.5 mm long, basal spurred, dehiscent longitudinally; anther-crest 1–3 × 2.5–4 mm, apex trilobed or entire, extended and recurved. Stigma ca. 1 × 1 mm, funnel-shaped, hairy. Ovary 1–2 × ca. 1 mm, hairy, unilocular, ca. 2 ovules. Epigynous glands 2, filiform, ca. 5 mm long. Fruit ellipsoid, ca. 11 × 7 mm, wall thin, fleshy, near transparent, enclosed 2–3 seeds. Seed kidney-shaped, ca. 7 × 3 mm, covered with aril.



**FIGURE 3.** *Scaphochlamys endauensis*. **A.** Habit. **B.** Inflorescence. **C.** Flower. Photo A by Y.Y. Sam, B & C by K. Imin.



**FIGURE 4.** *Scaphochlamys endauensis*. **A.** Habit. **B.** Hairs on under surface midrib. **C.** Floral bract. **D.** First bracteole. **E.** Ovary and calyx. **F.** Lateral corolla lobe. **G.** Dorsal corolla lobe. **H.** Staminode. **I.** Labellum. **J.** Stamen front view (J'), side view (J''), back view (J'''). **K.** Stigma front view. **L.** Fruit. **M.** Seed front view (M'), side view (M''). A–M from Y.Y. Sam, K. Apok & H.L. Kueh FRI 50204 (KEP).

**Etymology:**—The epithet ‘Endau’ refers to the Endau River and its tributaries that flow through the state park where the plants are most commonly found and abundant.

**Distribution and habitat:**—Endemic in Johor, Peninsular Malaysia. Lowland dipterocarp forest, 25–370 m elevation, forest floor, level and undulating terrain, in shaded areas.

**Conservation status:**—Near Threatened, NT. The species meets the area requirements under criterion B for Endangered (extent of occurrence = 262 km<sup>2</sup> and area of occupancy = 16 km<sup>2</sup>). However, the plants are commonly found and well protected in Endau Rompin State Park, a Totally Protected Area. Among all the known locations, only the populations in the Lenggor Forest Reserve are threatened by logging but this is unlikely to cause the species to extinct or becoming critically endangered in the future. Therefore, the listing is justified under the NT category (IUCN, 2012).

**Additional specimens examined (paratypes):**—PENINSULAR MALAYSIA. Johor: Mersing, Gunung Janing, 20 October 1892, *H.W. Lake & H. Kelsall s.n.* (SING!); Gunung Janing Barat, base of sandstone rock face, 15 May 1985, *R. Kiew RK 1727* (SING!); 27 August 1985, *R. Kiew RK 1909* (KEP!); Island at Kuala Kemapan, downstream end, bank of Sungai Endau, downstream from Kuala Kemapan, 5 September 1985, *K.M. Wong FRI 30894* (KEP!); Endau Rompin State Park, Kuala Jasin, trail to Gunung Janing Barat, 103° 22.13' E, 2° 31.83' N, 370 m, 9 August 2006, *Y.Y. Sam FRI 50205* (KEP!); Endau Rompin State Park, NERC, trail to dam, 25 m, 10 August 2006, *Y.Y. Sam FRI 50210* (KEP!); Segamat, Endau Rompin State Park, Sungai Selai, across Sungai Selai, on the ridge, 200 m, 16 August 2002, *Y.Y. Sam FRI 47096* (KEP!); *Sam Y.Y. FRI 47097* (KEP!); 60 m, 3 April 2007, *Y.Y. Sam FRI 50218* (KEP!); Kluang, Lenggor Forest Reserve, 7 December 2006, *Y.Y. Sam FRI 50243* (KEP!).

**Discussion:**—*Scaphochlamys endauensis* is common on the forest floor of Endau Rompin State Park. Previously, the plant was wrongly identified as *S. oculata* Holttum (1950: 92). However, both are very different upon close examination, differing in the number of flowers in each cincinnus (*S. oculata* has 1–3 flowers in each cincinnus compared to 4–7 flowers in *S. endauensis*) and the distinctive coloured streaks beside the yellow median band on the labellum (*S. oculata* has bright red streaks but they are purple in *S. endauensis*).

*Scaphochlamys endauensis* Holttum (1950: 95) is actually more similar to *S. breviscapa*. However, these two species are different principally in the cross section of petiole (channelled in *S. endauensis* versus terete in *S. breviscapa*) and the size of bladeless sheath (6.5–10.5 cm long in *S. endauensis* versus 11.5–18 cm long in *S. breviscapa*). In addition, the leaf sheath of *S. endauensis* (1.5–1.8 cm) is consistently longer than *S. breviscapa* (0.7–1 cm). Its lamina is elliptic to oblanceolate with broadly acute to obtuse apex and cuneate to attenuate base whereas *S. breviscapa* has elliptic to broadly ovate lamina with acute apex and rounded or cuneate base. Furthermore, *S. endauensis* has larger floral bracts (30–35 × 11–13 mm) as compared to *S. breviscapa* (20–30 × 7–17 mm). The staminodes of *S. endauensis* is oblanceolate with broadly acute to near rounded apex which differ from the linear ones with truncate apex in *S. breviscapa*.

Both *S. endauensis* and *S. breviscapa* are found on the East Coast Range of Peninsular Malaysia. The mountainous range extends from northeast to south of the peninsula and at the central part, it is intercepted by large swamps (Raj, 2009). *Scaphochlamys breviscapa* is distributed in the Terengganu Highlands in Terengganu and Pahang whilst *S. endauensis* is found at the south of Peninsular Malaysia.

### 3. *Scaphochlamys johorensis* Y.Y. Sam, *sp. nov.* (Figs. 5–6)

*Scaphochlamys johorensis* is similar to *S. burkillii* but differs in the number of leaves in each leafy shoot; *S. johorensis* is unifoliate whereas *S. burkillii* has 3–4 leaves in each shoot.

**Type:**—PENINSULAR MALAYSIA. Johor: Kluang Forest Reserve, Gunung Belumut, 23 July 2009, *S. Syahida-Emiza FRI 66566* (holotype: KEP!, isotypes: KLU!, SING!).

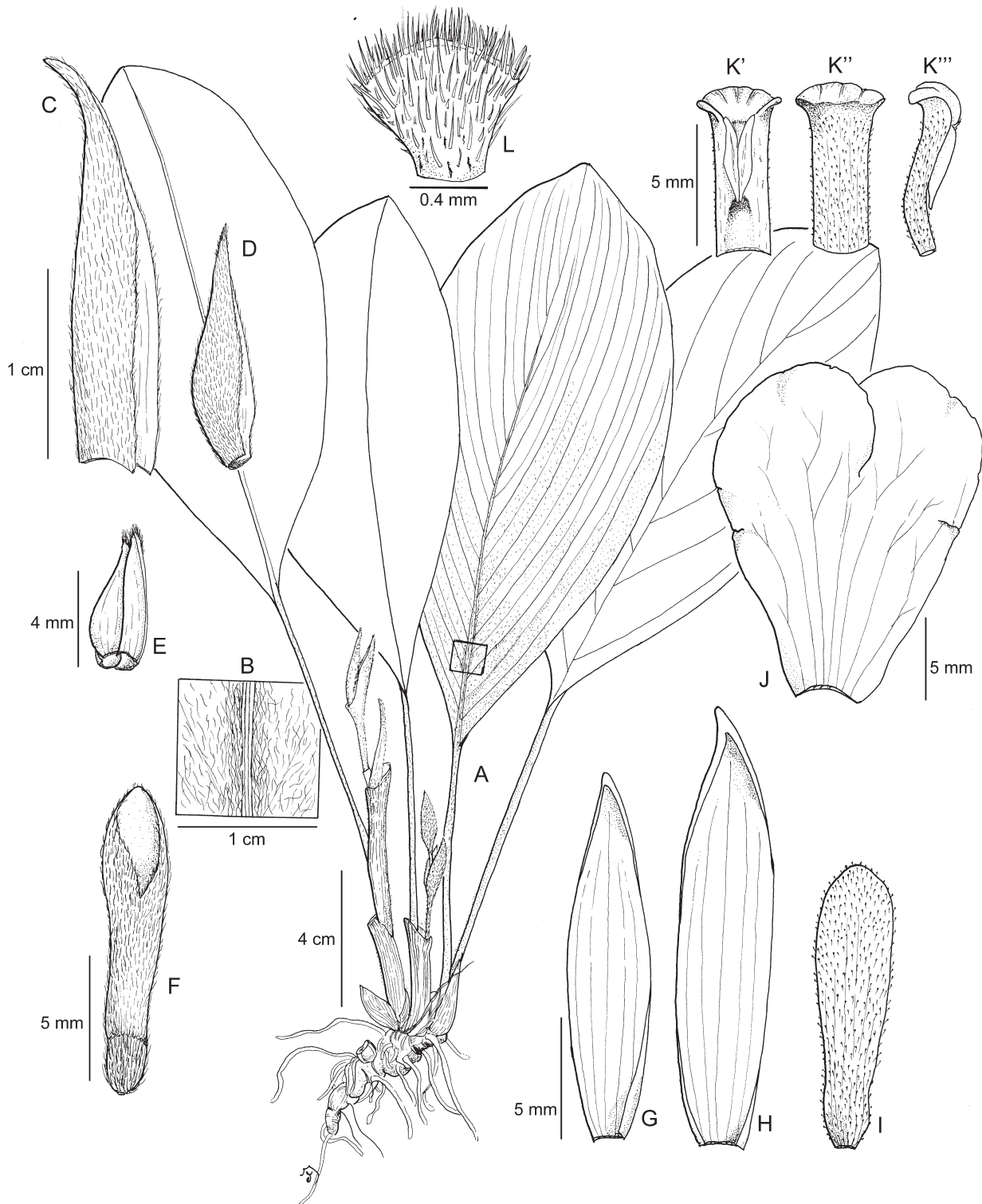
Rhizomatous herb, 30–50 cm tall. Rhizome 4–7 mm diameter, creeping horizontally near ground surface. Successive shoots clustering and forming loose clumps of 2–5 leafy shoots, usually less than 1.5 cm apart. Bladeless sheath 1–2, largest 6.5–9 cm long, covered densely with long fine hairs, light purple red when young, turning to green, persistent till flowering, enclosing the young inflorescence and leaf petiole. Leaf 1 per shoot, rarely 2; sheath 2.5–4 cm long, broad to 5 mm width, membranous, hairy; ligule ca. 5 mm long, triangular, membranous, hairy; petiole plus sheath 6.5–21 cm long, channelled, densely covered with bronze woolly hairs especially when young; lamina 14.3–22 (26–32) × 6.8–8.5 (10.5–12.5) cm, elliptic to broadly elliptic, thickly coriaceous, held horizontally, base cuneate or long attenuate, apex acute, adaxial surface glossy dark green or green with 2 white bands along the edges, glabrous, abaxial surface pale green, some tinged purple when young, densely covered with long fine appressed hairs especially along midrib. Inflorescence 7.5–16.5 cm long, hairy throughout; peduncle 2–3(7.5–10.5) cm long; rachis 5.5–6.5 cm long, axis visible, floral bracts 4–7(–10), lax. Floral bract 23–25 mm long, boat-shaped with margin inflexed

but not overlapped, stiff, coriaceous, green or purple red, densely covered with woolly hairs, apex acute and pointed upright. First bracteole 12–13 mm long, near triangular when flattened, 2-keeled, margin inflexed but not overlapped, densely woolly hairy, apex acute; subsequent bracteoles 5–6 × 3–4 mm, about half the length of first bracteole, broadly triangular when flattened, 2-keeled, hairy. Flowers 43–45 mm long, white, except labellum; at least 12 flowers in each cincinnus. Calyx ca. 10 mm long, tubular, hairy, split ca. 4 mm unilaterally from apex. Floral tube ca. 24 mm long; dorsal corolla lobe 14–18 × ca. 4 mm, linear, margin inflexed, apex hooded and ending with ca. 2 mm pointed tip that bent forward, lateral corolla lobes 12–15 × ca. 4 mm, linear, apex acute and hooded, ending with short pointed tip. Staminodes ca. 12 × 4 mm, oblanceolate, apex obtuse, adaxial surface covered by glandular hairs. Labellum 17–20 × 15–16 mm, obovate, apex bilobed, cleft ca. 7 mm from apex, abaxial surface covered with glandular hairs, yellow median band with violet streaks at the base. Stamen ca. 7 mm long, covered by glandular hairs on abaxial surface; filament less than 1 mm long; pollen sacs ca. 3 mm long, basal spurred, dehiscing longitudinally; anther-crest ca. 2 × 4 mm, extended and trilobed, midlobe largest. Stigma ca. 1 × 1 mm, funnel-shaped, hairy. Ovary ca. 2 × 2 mm, hairy, unilocular. Epigynous glands filiform, two, ca. 3 mm long.



**FIGURE 5.** *Scaphochlamys johorensis*. **A.** Habit. **B.** Flower. Photos by S. Syahida-Emiza.





**FIGURE 6.** *Scaphochlamys johorensis*. A. Habit. B. Hairs on midrib on abaxial surface. C: Floral bract. D. First bracteole. E. Second bracteole. F. Ovary and calyx. G. Lateral corolla lobe. H. Dorsal corolla lobe. I. Staminode. J. Labellum. K. Stamen front view (K'), back view (K''), back view (K'''). L. Stigma front view. A–L from *S. Syahida-Emiza* FRI 66566 (KEP).

**Etymology:**—The epithet refers to the state where the plants are found.

**Distribution and habitat:**—Endemic in Johor, Peninsular Malaysia. Lowland to upper hill dipterocarp forest, 100–946 m elevation, riverbanks, in shaded areas.

**Conservation status:**—Endangered, EN B2ab(iii). The species has an area of occupancy of 12 km<sup>2</sup> and it is recorded from only 3 locations. Furthermore, the continuing decline arising from timber harvesting in Lenggong Forest

Reserve is projected to affect the quality of the habitat. The population on Gunung Belumut occurs near the trail to the summit which is frequently used by climbers. Based on the criteria in IUCN (2012), the species is justified to be listed as Endangered.

**Additional specimens examined (paratypes):**—PENINSULAR MALAYSIA. Johor: Kluang, Kluang Forest Reserve, Gunung Belumut, 25 July 1939, *F. Walker FMS 33828* (KEP!), path to Gunung Belumut, 23 September 1970, *M.N. Mohd. Shah & A. Samusi MS 2164* (SING!); Lenggong Forest Reserve, Bukit Tinggi, *P.T. Ong FRI 70839* (KEP!).

**Discussion:**—*Scaphochlamys johorensis* resembles *S. burkillii* Holttum (1950: 102) in having dense hairs on most parts of the plant. In addition, both have green, boat-shaped floral bracts with involute edges. However, they can be distinguished by the number of leaves on each leafy shoot. *Scaphochlamys johorensis* has only one leaf in each shoot while *S. burkillii* has 3–4 leaves. *Scaphochlamys burkillii* has a very long distinct leaf sheath, sometimes almost reaching the lamina base, a characteristic not observed in *S. johorensis*.

The inflorescence structure of *S. johorensis* also differs from *S. burkillii*. *Scaphochlamys johorensis* has a very compact rachis consisting of 8–22 floral bracts which closely overlap and completely hiding the axis. On the contrary, *S. burkillii* has a lax rachis and fewer floral bracts (4–7) which are spaced apart showing the axis. The floral bracts of *S. johorensis* are smaller (23–25 versus 33–39 mm) but it consists of more flowers (more than 12 versus 4–7) in each cincinnus compared to *S. burkillii*.

Both *S. johorensis* and *S. burkillii* are found on the East Coast Range of Peninsular Malaysia but their distribution is not sympatric. *Scaphochlamys johorensis* is recorded from the south of Peninsular Malaysia but *S. burkillii* is distributed northerly in Pahang, separated by large swamps (Raj, 2009) in between them.

#### 4. *Scaphochlamys tahanensis* Y.Y. Sam & Saw, *sp. nov.* (Figs. 7–8)

*Scaphochlamys tahanensis* is most similar to *S. concinna* but differs in having a channelled petiole compared to the terete petiole in *S. concinna*. *Scaphochlamys tahanensis* also differs in its cuneate or attenuate lamina base versus the cordate base in *S. concinna*.

**Type:**—PENINSULAR MALAYSIA. Pahang: Lipis, Taman Negara, Sungai Tanum Basin, Kuala Juram, 31 July 1996, *L.G. Saw FRI 44667* (holotype: KEP!, isotypes: AAU!, K!).

Rhizomatous herb, 30–50 cm tall, successive shoots clustering close together. Rhizome 2–3 mm diameter when dried. Bladeless sheath 2–3, largest 6.5–13 cm long, brownish purple, persistent. Leaf 1 per shoot, glabrous; sheath 2–3 cm long, thin, base slightly swollen; ligule small, less than 1 mm long; petiole plus sheath 10.5–27.5 cm long, channelled; lamina 18–31 × 3.1–4.3 cm, narrowly elliptic to lanceolate, apex attenuate, base cuneate or attenuate. Inflorescence 4.5–10 cm long, glabrous; peduncle 1.2–7 cm long; rachis 2.5–4 cm long, compact, axis not visible, composed of 4–10 red floral bracts, bracts overlapping and closely appressed to axis. Largest floral bracts 21–40 mm long, boat-shaped, 9–13 mm width when flattened, glabrous, texture coriaceous, not stiff, margin incurved but not overlapping, apex narrowly acute, pointed upright. Cincinnus with 2–3 flowers in each bract. First bracteole 18–36 mm, near linear with margin inflexed and overlapped, 2-keeled, glabrous, apex narrowly acute; subsequent bracteoles reducing in size. Flowers 50–55 mm long, white, except labellum; exert 5–10 mm from floral bracts. Calyx 10–14 mm long, tubular, glabrous, unilaterally split 5–6.5 mm from apex, apex acute. Floral tube 32–38 mm long; dorsal corolla lobe 14–17 mm long, near triangular, edges inflexed, apex hooded and ending with pointed tip; lateral corolla lobes 12–16 mm, edges inflexed, apex acute. Staminodes 10–14 × 5–6 mm, oblanceolate, apex rounded, adaxial surface covered by glandular hairs. Labellum 17–22 × 15–17 mm, obovate, apex bilobed, lobes overlapped, cleft 5–9 mm from apex, abaxial surface covered with glandular hairs, yellow median band with red streaks at both sides. Stamen ca. 7 mm long, covered by glandular hairs on abaxial surface; filament ca. 2 mm long; pollen sacs ca. 4.5–5 mm long, basal spurred, dehiscing longitudinally; anther-crest ca. 1 × 2 mm, not extended and not recurved. Stigma less than 1 × 1 mm, beak-like, ostiole narrow and facing front, ciliate. Ovary 2–3 × ca. 2 mm, glabrous, unilocular, ca. 6 ovules. Epigynous glands filiform, two, 7–10 mm long.

**Etymology:**—The epithet refers to Gunung Tahan where the plants were found.

**Distribution and habitat:**—Endemic to Taman Negara, Pahang, Peninsular Malaysia. Lowland dipterocarp to upper hill forest, 30–1098 m elevation, riverbanks, in shaded areas.

**Conservation status:**—Rare, RA. Healthy and abundant populations are found from the foothills to hill slopes of Gunung Tahan within Taman Negara. The RA category was created under the Malaysian Plant Red List for taxa that are rare but not threatened by extinction (Chua 2012). However, taxa that fall under this classification should be given due attention in conservation decision-making and processes.

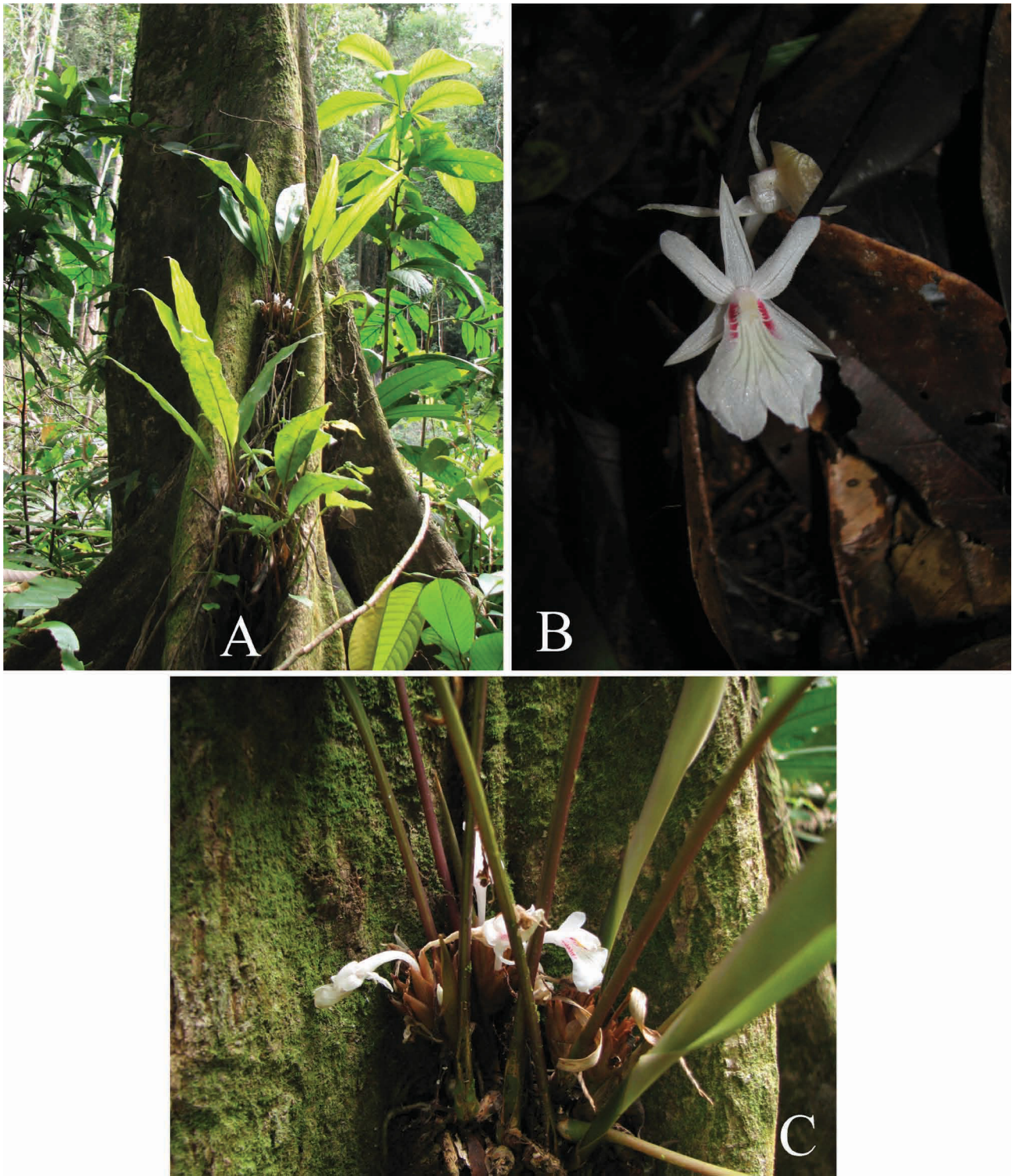
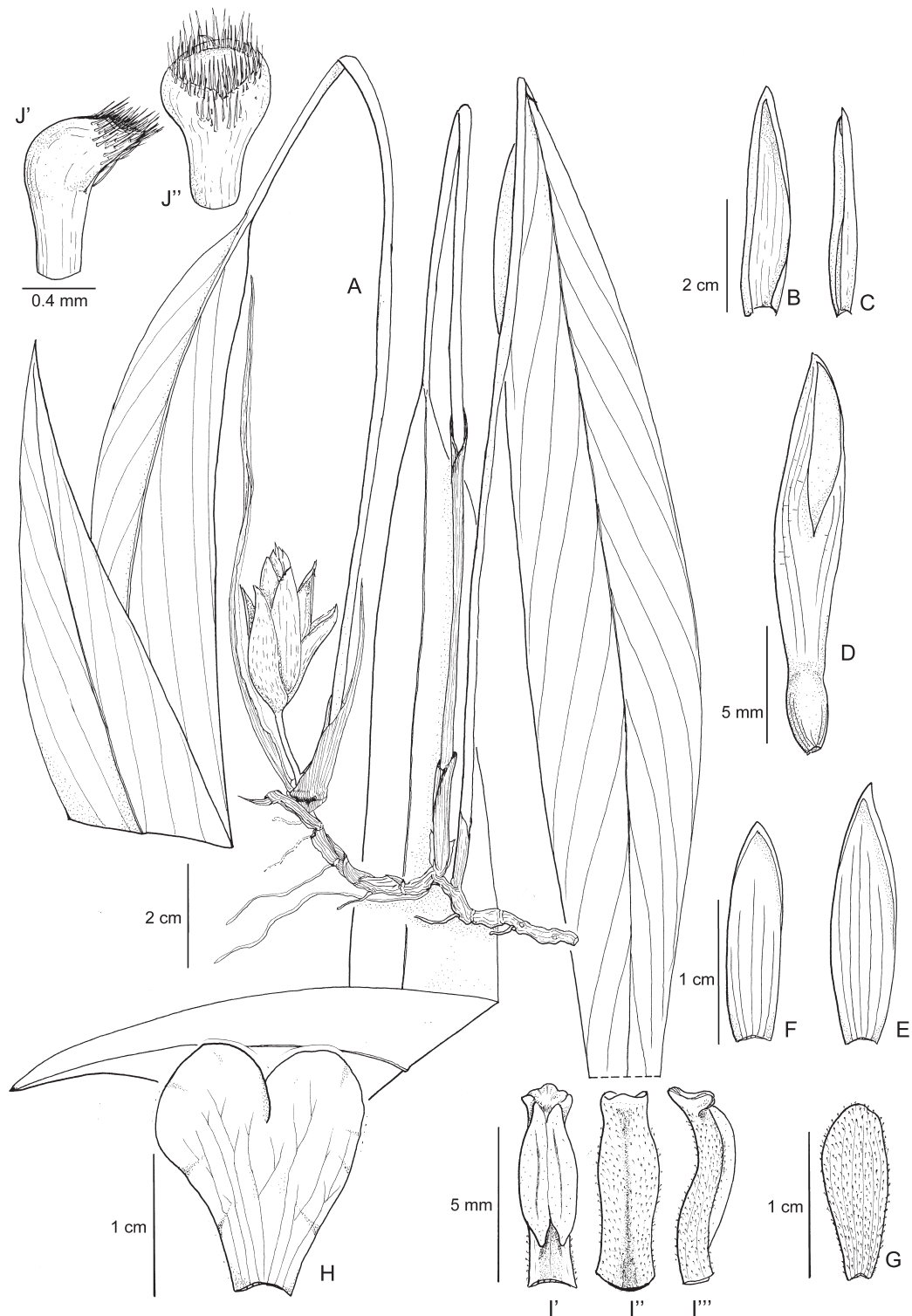


FIGURE 7. *Scaphochlamys tahanensis*. A. Habit. B. Flower. C. Inflorescence. by K. Imin.

**Additional specimens examined (paratypes):**—PENINSULAR MALAYSIA. Pahang: Merapoh, near base camp, 22 June 1995, *H.C. Ong* 633 (KLU!); Lipis, Taman Negara, Gunung Tahan, Kem Koh, ascent from Merapoh, 650 m, 3 August 1996, *R. Kiew* RK 4034 (KEP!); ascent from Merapoh HQ, 1098 m, 7 August 1996, *R. Kiew* RK 4120 (KEP!); Kuala Juram, Sungai Tanum, 30 m, 5 May 1997, *L.S.L. Chua* FRI 38849 (KEP!); Camp Kor, Kor Camp site, 479 m, 6 May 2008, *K. Imin* FRI 63068 (KEP!, SAN!, SING!).

**Discussion:**—*Scaphochlamys tahanensis* is close to *S. concinna* Holttum (1950: 94) with both having long, narrow leaves and red, short and compact inflorescences. In addition, both also have conspicuously large white flowers with red streaks beside the yellow median band on the labellum. Nevertheless, *S. tahanensis* is easily distinguished by its very narrow lamina with the ratio length to width of 5.6–9.8. The similar looking *S. concinna* has lower ratio

of 2.6–4.3 and its shape is narrowly lanceolate to ovate with strongly cordate base whereas *S. tahanensis* is narrowly elliptic to lanceolate with cuneate or attenuate base. Other differences are observed in the inflorescence structure. For example, the inflorescence rachis of *S. tahanensis* is 2.5–4 cm long and it consists of 4–10 floral bracts whereas *S. concinna* has longer rachis (4–4.5 cm) because it consists of more bracts (about 14 bracts). The difference in the cross section of petiole in *S. tahanensis* and *S. concinna* further supports their specific status. The petiole in cross section is characteristic to each species and all the *Scaphochlamys* species observed so far fall nicely into either one of these two groups (channelled versus terete petiole).



**FIGURE 8.** *Scaphochlamys tahanensis*. **A.** Habit. **B.** Floral bract. **C.** First bracteole. **D.** Ovary and calyx. **E.** Dorsal corolla lobe. **H.** Lateral corolla lobe. **G.** Staminode. **H.** Labellum. **I.** Stamen front view (I'), back view (I''), back view (I'''). **J.** Stigma side view (J'), front view (J''). **A–J** from L.G. Saw FRI 44667 (K).

*Scaphochlamys tahanensis* and *S. concinna* are not sympatric because they occupy different locations. *Scaphochlamys tahanensis* is found along the trail at the western entry point to Gunung Tahan, the highest peak in Peninsular Malaysia. Gunung Tahan is located in the Tahan Range, a mountainous range disjunct from the Main Range where *S. concinna* is found.

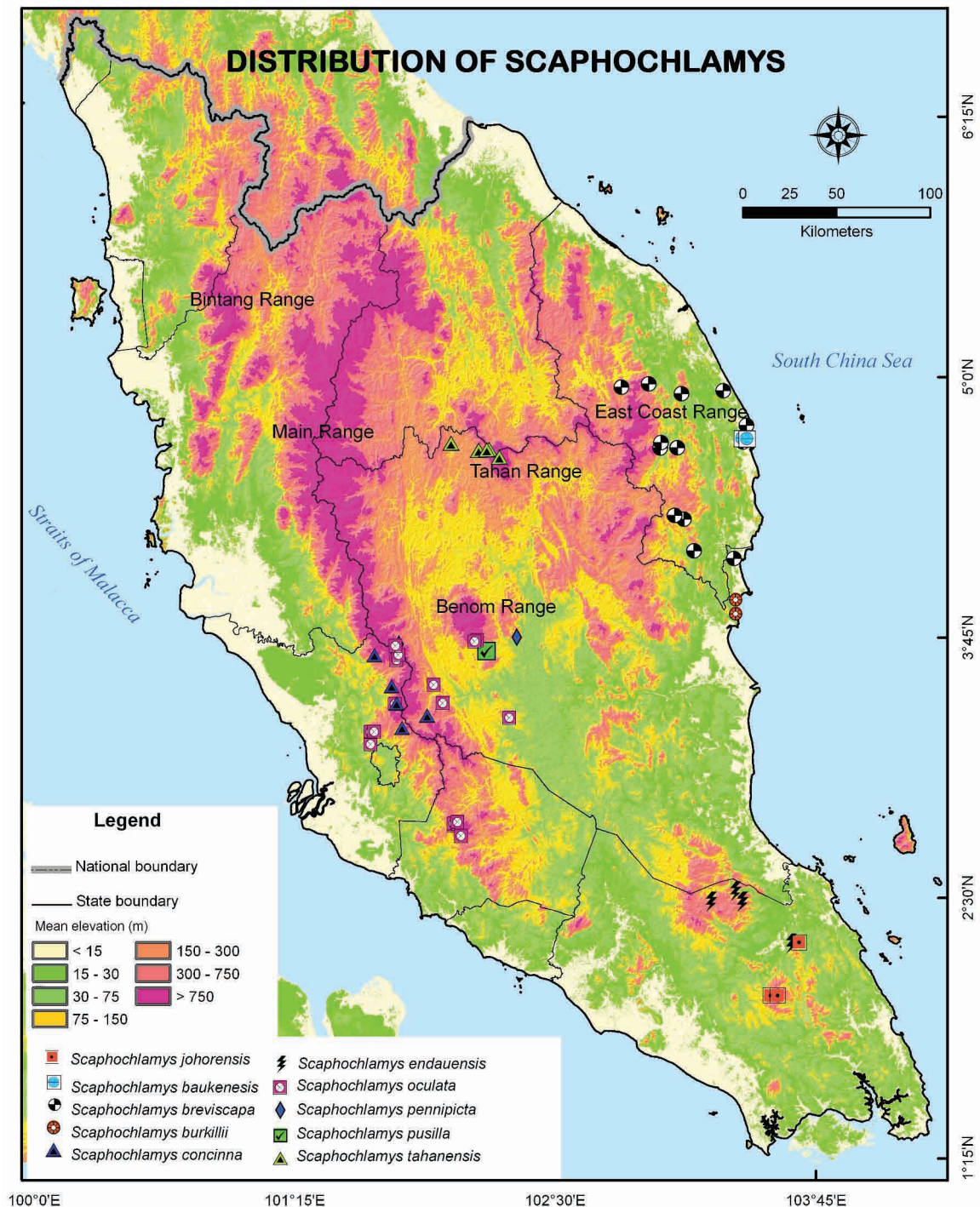


FIGURE 9. Distribution of *Scaphochlamys baukenesis*, *S. endauensis*, *S. tahanensis* and *S. johorensis* and their most similar taxa.

### Acknowledgements

We should like to thank the Forestry Department of Peninsular Malaysia, Terengganu and Johor Forestry Departments, Department of Wildlife and National Parks, and Johor Parks Corporation for permission to conduct research in their forests; Richard Chung Cheng Keong and Ruth Kiew for their critical comments and suggestions to improve the manuscript; Mohamad Aidil Noordin for preparing the line drawings; Hamidah Mamat for preparing the distribution

map; Malaysian Ministry of Higher Education through the Fundamental Research Grant Scheme (Project No. FP 075/2007C) and Ministry of Natural Resources and Environment under the “Kajian Perhutanan FRIM: Dokumentasi dan Inventori Flora Malaysia” (Project No. P23-085100010025) for their financial support.

## References

- Baker, J.G. (1892) Scitamineae. In: Hooker, J.D. (Ed.) *Flora of British India* 6. Reeve & Co., London, 252 pp.
- Chua, L.S.L. (2012) Conservation. In: Kiew, R., Chung, R.C.K., Saw, L.G. & Soepadmo, E. (Eds.) *Flora of Peninsular Malaysia: Series II: Seed Plants*. Vol. 3. Forest Research Institute Malaysia, Kepong, pp. 3–10.
- Holtum, R.E. (1950) The Zingiberaceae of Malay Peninsula. *Gardens' Bulletin Singapore* 13: 82–105.
- IUCN (2012) *IUCN Red List Categories and Criteria: Version 3.1*. Second Edition, Gland, Switzerland and Cambridge, UK: IUCN, iv + 32 pp.
- Jenjittikul, T. & Larsen, K. (2002) Two new species of *Scaphochlamys* (Zingiberaceae) from Thailand. *Nordic Journal of Botany* 22: 35–38.  
<http://dx.doi.org/10.1111/j.1756-1051.2002.tb01616.x>
- Larsen, K. (1962) Notes on two Malayan species of *Scaphochlamys*. *Saertryk af Botanisk Tidsskrift* 58: 191–203.
- Meekiong, K., Ipor, I., Tawan, C.S., Ibrahim, H., Norhati, M.R., Lim, C.K. & Ampeng, A. (2011) Five new ginger species (Zingiberaceae) from the eastern part of Lanjak Entimau Wildlife Sanctuary, Sarawak, Borneo. *Folia Malaysiana* 12: 9–26.
- Morley, R.J. (2000) *Origin and evolution of tropical rain forests*. John Wiley & Sons Ltd., Chichester, Englan, 362 pp.
- Poulsen, A.D. & Searle, R.J. (2005) *Scaphochlamys calcicola* (Zingiberaceae): a new and unusual species from Borneo. *Gardens' Bulletin Singapore* 57: 29–35.
- Quek, S.P., Davies, S.J., Ashton, P.S., Itino, T. & Pierce, N.E. (2007) The geography of diversification in mutualistic ants: a gene's-eye view into the Neogene history of Sundaland rain forests. *Molecular Ecology* 16: 2045–2062.  
<http://dx.doi.org/10.1111/j.1365-294X.2007.03294.x>
- Raj, J.K. (2009) Geomorphology. In: Hutchison, C.S. & Tan, D.N.K. (Eds.) *Geology of Peninsular Malaysia*. The University of Malaya and Geological Society of Malaysia, Kuala Lumpur, pp. 5–28.
- Sam, Y.Y., Ibrahim, H. & Saw, L.G. (2010) *Scaphochlamys krauensis* and *S. pusilla* spp. nov. (Zingiberaceae) from Krau Wildlife Reserve, Pahang, Peninsular Malaysia. *Nordic Journal of Botany* 28: 673–679.  
<http://dx.doi.org/10.1111/j.1756-1051.2010.00733.x>
- Sam, Y.Y. & Saw, L.G. (2005) Three new species of *Scaphochlamys* (Zingiberaceae) from Peninsular Malaysia. *Gardens' Bulletin Singapore* 57: 253–261.
- Searle, R.J. (2010) The genus *Scaphochlamys* (Zingiberaceae - Zingibereae): A compendium for the field worker. *Edinburgh Journal of Botany* 67: 75–121.  
<http://dx.doi.org/10.1017/S0960428609990254>
- Siriruga, P. & Larsen, K. (1991) A new species of *Scaphochlamys* (Zingiberaceae) from Thailand. *Nordic Journal of Botany* 11: 93–95.  
<http://dx.doi.org/10.1111/j.1756-1051.1991.tb01802.x>
- Smith, R.M. (1987) A review of Bornean Zingiberaceae: III (Hedychieae). *Notes of the Royal Botanic Gardens Edinburgh* 44: 203–232.
- Tnah, L.H., Lee, S.L., Ng, K.K.S., Lee, C.T., Bhassu, S. & Rofina Yasmin, O. (2013) Phylogeographical pattern and evolutionary history of an important Peninsular Malaysian timber species, *Neobalanocarpus heimii* (Dipterocarpaceae). *Journal of Heredity* 104 (1): 115–126.  
<http://dx.doi.org/10.1093/jhered/ess076>