

Two new species, *Codonoboea fraserensis* (Gesneriaceae) and *Curculigo elegantissima* (Hypoxidaceae), from Fraser's Hill, Peninsular Malaysia

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ABSTRACT. Two new species, *Codonoboea fraserensis* Kiew (Gesneriaceae) and *Curculigo elegantissima* Kiew & Škornič. (Hypoxidaceae) from Fraser's Hill (Bukit Fraser), Pahang, Peninsular Malaysia are described and illustrated here. Notes on distribution, ecology and etymology are given. Both species are currently considered endemic in the area with provisional IUCN conservation assessments of Endangered and Vulnerable respectively.

Keywords. Asparagales, Bukit Fraser, Endangered, endemic, Lamiales, Pahang, Vulnerable

Introduction

The flora of the hill and montane forests at about 800–1400 m elevation at Fraser's Hill (Bukit Fraser, Pahang/Selangor border, Peninsular Malaysia) is relatively well-known botanically, being the only mountain in Peninsular Malaysia with an existing checklist of 952 species of gymnosperms and angiosperms (Kiew, 1998). Yet its flora continues to reveal numerous novelties (e.g. Utteridge, 2012; Julius et al., 2013; Dubéarnès et al., 2015), either as the result of catching a species in flower, as in the case of the *Codonoboea* Ridl. described below, or because the group is poorly known, as for *Hanguana* Blume (Leong-Škorničková & Kiew, 2016) or *Curculigo* Gaertn., also described below. A forthcoming guide to the flowers of Fraser's Hill (Kiew & Leong-Škorničková, in prep.), as well as an updated version of the Checklist with about 1500 species of vascular plants (Kiew & Aliaa-Athirah, in prep.), has prompted the need to publish their scientific names. Both species grow in the vicinity of the Fraser's Hill township at about 1200 m elevation in lower montane forest.

Codonoboea (Gesneriaceae) is the largest genus of dicotyledonous herbs in Peninsular Malaysia (Kiew, 1991). Kiew & Lim (2011) listed 79 species but new species continue to be discovered and described (Kiew, 2011; Kiew & Sam, 2012; Lim et al., 2013; Kiew, 2014; Kiew & Lim, 2019; Syahida-Emiza et al., 2020), bringing the

current total to 89 species. Fraser's Hill is a biodiversity hotspot for *Codonoboea* and is home to a very diverse flora of 11 species, two of which, *Codonoboea curtisii* (Ridl.) C.L.Lim and *C. pumila* (Ridl.) C.L.Lim are endemic to Fraser's Hill (Kiew, 1998).

Curculigo species (Hypoxidaceae) in Peninsular Malaysia are readily recognised as small to robust herbs with rosettes of strongly plicate leaves and bright yellow, star-like flowers. The generic delimitation of *Curculigo* and *Molineria* Colla has been confused because morphological characters postulated to separate them overlap (Hilliard & Burt, 1978). Geerinck (1993) described them under *Curculigo*, while Turner (1997) listed the Peninsular Malaysian species under *Molineria*. Recent molecular analysis of Hypoxidaceae including all the Peninsular Malaysian taxa (Kocyan et al., 2011) demonstrated that these two genera are not distinct but form a polyphyletic group of species. They concluded that the two genera cannot be maintained as separate, with *Curculigo* taking precedence over *Molineria*. The genus is still poorly known and grossly understudied in Peninsular Malaysia with only two species, one with two varieties, recognised (Geerinck, 1993).

Materials and methods

Both species were discovered during botanical surveys and the descriptions are based on live flowering material which was subsequently processed and deposited as herbarium specimens in K, KEP, SAN and SING; herbarium acronyms follow Thiers (continuously updated). Examination of relevant publications and specimens in K, KEP, KLU and SING enabled the new species to be compared with named species. Type specimens not held in the above herbaria were accessed from JSTOR Global Plants (<http://plants.jstor.org>). All specimens cited were seen by the authors. Literature relevant to the region (West Malesia and Thailand) was consulted. Conventional methods employed in herbarium taxonomy were applied in this study. The provisional conservation assessments are based on the guidelines of the IUCN Standards and Petitions Committee (2022).

Taxonomy

Codonoboea fraserensis Kiew, **sp. nov.**

Codonoboea fraserensis most resembles *C. malayana* (Hook.f.) Kiew in its long-stalked thyse with pairs of very large, yellow, trumpet-shaped flowers more than 30 mm long, and capsules 25–35 mm long that are upturned and relatively thick at least 2 mm. It is different in its habit being a robust erect plant to 40–80 cm tall (vs creeping plant 7.5–20 cm in *C. malayana*), in its broader, velvety, mid-green, elliptic to lanceolate leaves, 13–20.5 × 5.5–9.2 cm with 9–13 lateral veins on either side of the midrib (vs silky silvery, broadly oval and 6.5–15 × 2.5–5 cm with 6–9 lateral veins), longer petioles 5.5–8.7 cm long (vs 2.5–3.5 cm long), longer peduncles 7–10 cm long (vs 5–6(–10) cm long) and longer corollas 45–50 mm long (vs 35–40 mm long). –

TYPE: Peninsular Malaysia, Pahang, Raub District, Fraser's Hill, Maxwell Trail, 2 October 2019, *R. Kiew & P.T. Ong FRI 90771* (holotype KEP [KEP300288]; isotype K, SAN, SING). (Figs. 1–4)

Robust, unbranched herb or sometimes branching at the base and forming clumps, branches sometimes falling and producing plantlets at 12 cm intervals. **Stems** erect and stout, 40–80 cm tall, 1–1.2 cm diam., woody at base, ridged below petiole. **Indumentum** of young stem, petiole and lamina of dense uniseriate hairs c. 1.5 mm long, especially dense and silky on leaf margins and lower surface of veins, upper lamina surface with an additional layer of shorter hairs c. 0.3 mm long giving the upper surface a velvety appearance. **Leaves** in distant pairs, towards the top of the stem, crowded and c. 1 cm apart; **petioles** 5.5–8.7 cm long, c. 4 mm diam., lower petioles longer than the upper, slightly grooved above; **laminas** elliptic to lanceolate, 13–20.5 × 5.5–9.2 cm, soft, slightly fleshy, velvety, mid-green with a faint yellow-green broad band along midrib, base cuneate to slightly decurrent, margin entire with a fine white fringe of hairs, apex acuminate; midrib impressed above, prominent beneath, lateral veins flat above, prominent beneath, ascending, 9–13 on either side of the midrib. **Inflorescences** axillary thyrses, one per axil from the upper two pairs of leaves, 11.5–15 cm long, with up to 3–6 pairs of flowers per peduncle, flowers held well above leaves on erect, stout, pale cream or white peduncles 7–10 cm long, c. 2 mm thick, rachis 2–4 cm long; bract pairs green, narrowly lanceolate, 7–10 × 1–1.5 mm, bracteoles similar, 4–6 × c. 0.75 mm; stalk of flower pairs 2–4 mm long, 2–3 mm thick. **Indumentum** of peduncle, pedicels, calyx, ovary and style of dense glandular white hairs. **Flowers** pendent, pairs flowering in sequence from the base, pedicels white, 4–6 mm long; **calyx** white with a green tip to the lobes, 5-lobed, lobes divided almost to base, tube c. 1 mm long, lobes 1.7–2 mm long, apex acute; **corolla** trumpet-shaped, pale yellow outside and white towards the base, inside lobes pale lemon-yellow with a large deep lemon-yellow patch in the throat and 2 deep lemon-yellow nectar guides running into the tube, minutely pubescent outside with moderately dense white glandular hairs c. 0.25 mm long, glabrous inside, 45–50 mm long, tube 32–37 mm long, 4–7.5 mm wide in the basal 12–17 mm, dilating to 10–15 mm wide across the mouth, lobes 5, rounded, upper two erect 7–12 × 5.5–10 mm, the two lateral lobes 7–11 × 5–8 mm and the lower lobe 8–10 × 7–9 mm and projecting horizontally by c. 10 mm, stamens and stigma positioned within the mouth; **stamens** 2, glabrous, attached c. 20 mm from corolla base, filaments c. 8 mm long, bowed, lower three quarters of the filaments yellow, upper quarter of filaments and anthers white, anthers small, c. 2 mm long, joined face-to-face, with two white glistening horn-like connectives c. 1 mm long at the apex, pollen white; **staminode** 1, slender, c. 2.5 mm long; **nectary** large, white, annular, c. 2 mm high, rim wavy; **ovary** pale green, 10–11 × 1.5–2 mm long; **style** white, 35–40 mm long, densely hairy; **stigma** peltate, 1.5–2 mm across, white. **Fruits** held at 30–45°, short-stalked, capsules stout, cylindric tapering to apex, slightly upcurved, 25–35 mm long, 2.5–3 mm thick.



Fig. 1. *Codonoboea fraserensis* Kiew. **A.** Inflorescences. **B.** Habit. From the type specimen *R. Kiew & P.T. Ong FRI 90771*. (Photos: P.T. Ong; reproduced with permission of the Flora of Peninsular Malaysia Project, Forest Research Institute Malaysia)

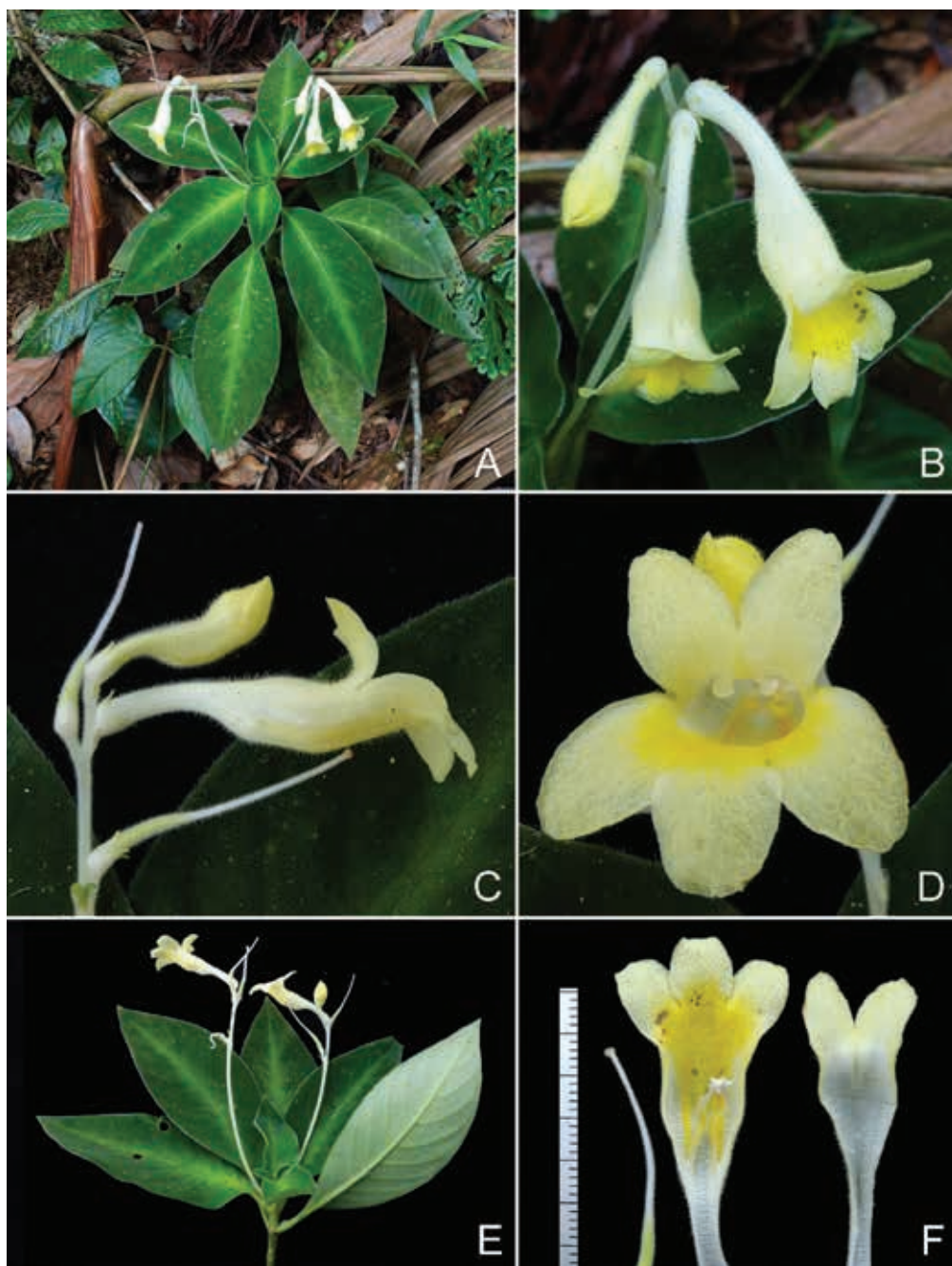


Fig. 2. *Codonoboea fraserensis* Kiew. **A.** Habit. **B.** Inflorescence. **C.** Flowers in various stages (side view). **D.** Flower (front view). **E.** Apical part of the plant with inflorescences. **F.** Dissected flower. From the type population at Maxwell Trail, photographed in September 2014. (Photos: J. Leong-Škorníčková)

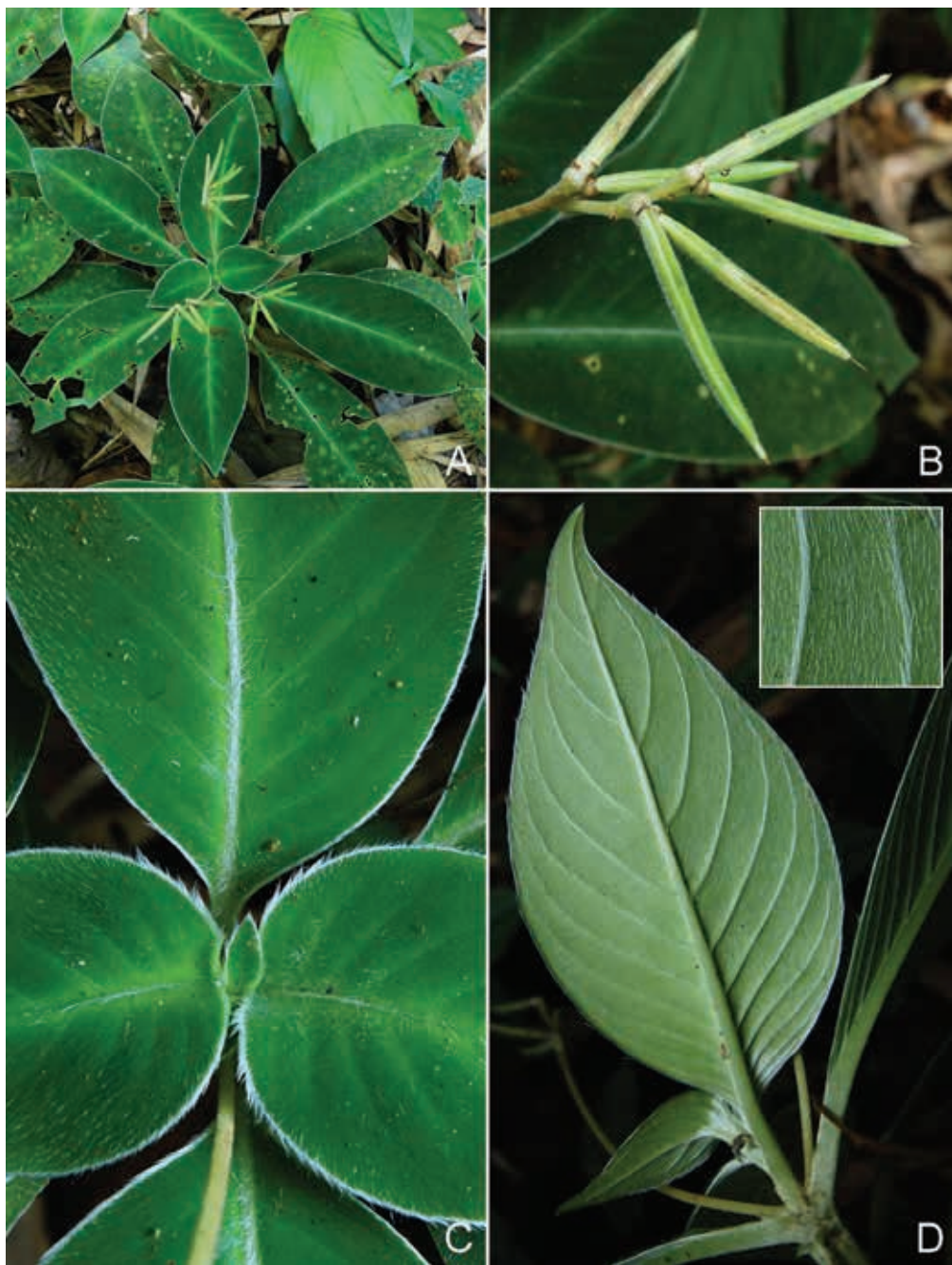


Fig. 3. *Codonoboea fraserensis* Kiew. **A.** Habit of plant with infructescences (top view). **B.** Infructescence. **C.** Detail of leaves showing the typical white fringe of fine hairs. **D.** Detail of leaves (abaxial side). Inset: Close-up of leaf abaxial side. From the type population at Maxwell Trail, photographed in September 2014 (Photos: J. Leong-Škorničková)

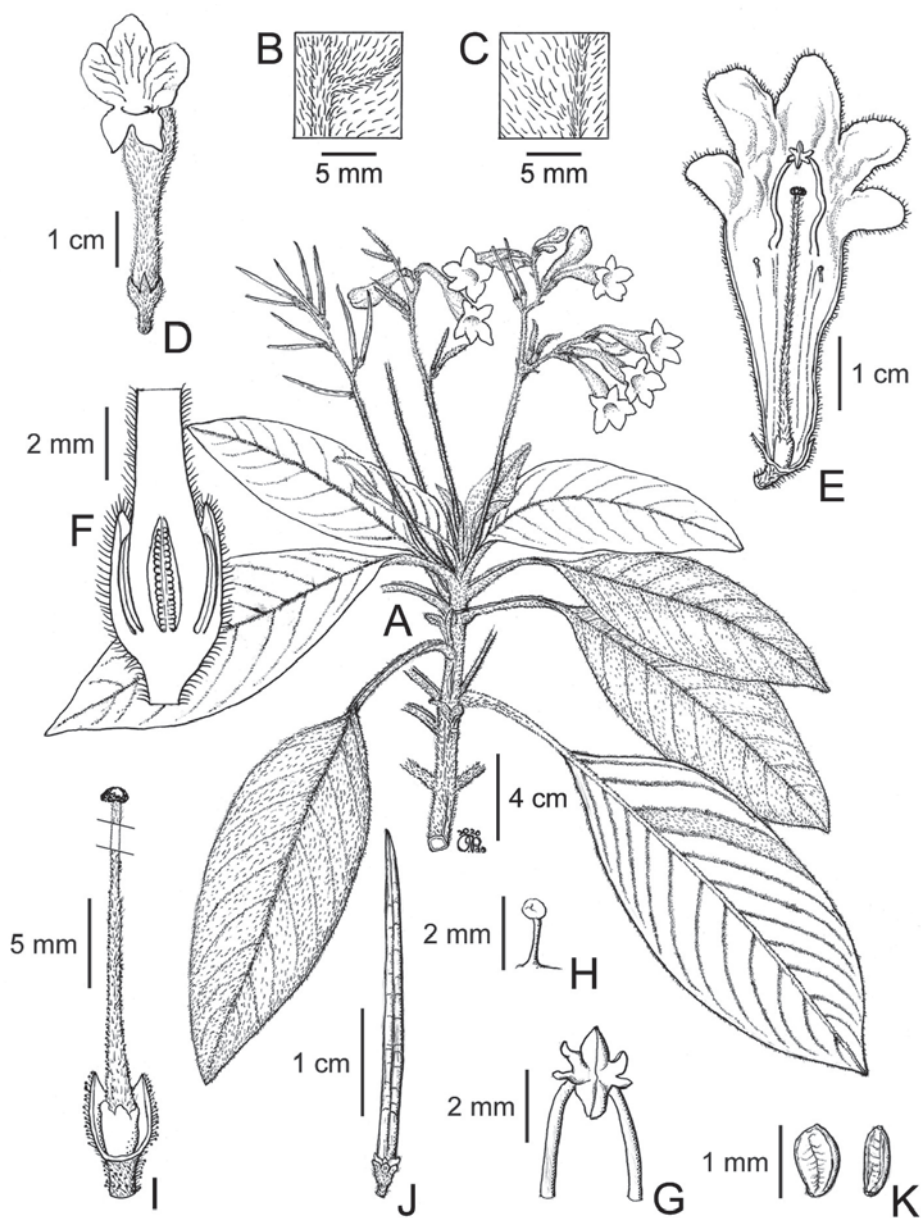


Fig. 4. *Codonoboea fraserensis* Kiew. **A.** Habit of plant with flowers. **B.** Lower leaf surface. **C.** Upper leaf surface. **D.** Flower. **E.** Calyx and corolla opened to show position of stamens and the nectary and carpel. **F.** Longitudinal section of carpel. **G.** Portion of filaments with anthers. **H.** Glandular hair from pedicel, outside of calyx and carpel. **I.** Carpel, nectary and longitudinal section of calyx. **J.** Fruit. **K.** Seed, front and side view. From type specimen *Kiew & Ong FRI 90771*. Drawn by Joseph Pao; reproduced with permission of the Flora of Peninsular Malaysia Project, Forest Research Institute Malaysia.

Distribution. Endemic in Peninsular Malaysia, known only from Pahang, Fraser's Hill, Maxwell Trail and Jeriau Valley, and Selangor about 5 miles before "The Gap".

Ecology. In hill dipterocarp forest to lower montane forest at 650–950 m, on steep earth slopes, in moderate shade, common in two extremely small, local subpopulations. It appears to grow at a slightly lower altitude than *Codonoboea malayana* (at 1200–1300 m), so their populations do not overlap.

Etymology. Named for Fraser's Hill, where it was first found.

Provisional IUCN conservation assessment. This species is known from three locations [subpopulations] in Fraser's Hill and the combined number of adult individuals in all subpopulations we have seen is slightly over 50 individuals. We therefore propose to provisionally assess this species as Endangered (EN D) until more evidence becomes available.

Additional specimens examined. PENINSULAR MALAYSIA: **Pahang:** Raub District, Fraser's Hill, small stream off path to Jeriau waterfall, 7 Oct 1983, *Kiew RK1240* (KEP [KEP34869]); ibidem, 16 Jul 2000, *Sam & Markandan FRI 47059* (KEP [KEP71584]); Maxwell Trail, 11 Mar 2012, *Kiew & Pannell FRI 75705* (KEP [KEP300290]); ibidem, 17 Jun 2019, *Kiew FRI 90765* (K, KEP [KEP300289], SING). **Selangor:** Ulu Selangor District, 5 miles before Gap from Kuala Kubu Bharu, 16 Mar 1985, *Kiew RK1630* (SING [SING0198640]).

Notes. The new species described here belongs to the 'malayana group' of species characterised by being herbs with distant pairs of leaves, thyrsoid inflorescences with long peduncles that hold the flowers high above the leaves, the large (3–5 cm long), trumpet-shaped flowers arranged in pairs, pendent on short pedicels, and the capsule relatively thick and often upcurved. *Codonoboea malayana* was the first species in this group to be described when in 1896 it was introduced into England and, on being exhibited at the Royal Horticultural Society on 14 July 1896, was awarded a First-class Certificate (Hooker, 1896). It was much admired for its beautiful large nodding yellow flowers up to 40 mm long.

Whereas *Codonoboea malayana* is widespread on the Main Range in Peninsular Malaysia (from Gunung Korbu, Perak, to Genting Bidai, Selangor), this new species is very rare and is currently known from three small subpopulations growing on steep slopes in upper hill to lower montane forest at Fraser's Hill, Pahang/Selangor. Until now it was overlooked probably because it flowers intermittently, but when in flower it is spectacular because almost all the plants in the subpopulation flower gregariously. It is a magnificent plant in its erect habit, velvety dark green leaves and, most especially, because of exceptionally large flowers 45–50 mm long, among the largest of any species in the genus *Codonoboea*.

Growth is in flushes with a new flush of leaves bearing inflorescences from their axils. The old fruits of the last flowering persist on the stem after their subtending leaves have fallen. As with many *Codonoboea* species, its flowering appears intermittent and not tied to any time of the year.

***Curculigo elegantissima* Kiew & Škorničk., sp. nov.**

Curculigo elegantissima is distinct from all other Southeast Asian congeners by its narrow leaf blades (length:width ratio 7.2–13.2) that are dark green above and strikingly deep glossy, purple-maroon beneath. – TYPE: Peninsular Malaysia, Pahang, Raub District, Fraser's Hill, Hemmant Trail, 16 June 2023, R. Kiew & J. Leong-Škorníčková FRI 90776 (holotype KEP [KEP300279]; isotype SING [SING0395278]). (Figs. 5, 6)

Robust terrestrial perennial rhizomatous herb, to 1.5 m tall. **Rhizome** somewhat elongated, vertical, 1.5–3 cm diam., crowned with persistent black-fibrous remnants of former leaves and bearing many fleshy roots; stolons present, 5–9 mm diam., slender, underground. **Leaves** spirally arranged, rosulate, 6–14 per plant, prominently petiolate with overlapping sheathing bases forming a short pseudostem; **petiole** up to 100 cm long (incl. sheathing base), sheathing base wide, green or with more or less rich maroon tinge and dark papery margins, the rest of the petiole 3–7 mm wide (measured just below the leaf blade), slender, sharply canaliculate, green, the margins with some long hair, otherwise glabrous; **leaf blade** 33–105 × 2.5–14.5 cm, narrowly lanceolate, with narrowly attenuate base and long-caudate apex (cauda 4.5–10 cm long), prominently plicate, adaxially dark green, nearly glabrous with sparse minute straight hairs, abaxially deep purple-maroon, with sparse appressed silky white hairs (1.5–4 mm long), soon becoming glabrescent, midrib slightly sunken above, prominent beneath, secondary main veins (excluding midrib) 8–15, forming up to 8 pleats on each side of the lamina (counted in the middle of the leaf blade). **Inflorescences** one to several per plant, arising among the leaves from lower leaf axils, erect to semi-erect, 6–16 cm long (extending with age and transitioning to infructescences), non-mucilaginous, pedunculate; **peduncle** 2.5–11.5 cm long, much flattened at base (narrowly lentiform in cross-section), 5–9 mm wide, terete distally, white, more or less covered in white to light golden-rusty stellate hairs, with up to 7 sheathing sterile bracts; **sterile bracts** narrowly triangular with sharply acute apex, lowermost two to 5.5 cm long, c. 1 cm wide at base, prominently keeled, distal ones 2–4 cm long, 0.8–1.2 cm wide at base, with no keel, abaxially white to greenish, sometimes with slight reddish tinge, with silky villous white or golden adpressed hairs towards the apex and the margins; **spike** 4–5 × 2–3.5 cm, compact, globose to sub-globose to ovate, composed of many spirally arranged fertile bracts (> 30); **fertile bracts** 2.5–3.5 cm long, 1.3–1.7 cm wide (measured at widest point 1/3 to 1/4 from the base), each subtending a single sessile flower, triangular-ovate with sharply acute to acuminate apex, largest at basal part of the inflorescence, distally gradually shorter and narrower, base white, becoming whitish green to pale green, tinged purple distally, adaxially glabrous, abaxially with silky villous white or golden adpressed hairs towards the apex and the margins. **Flowers** bisexual at the base of the inflorescence, transiting to functionally male flowers distally, 1.5–2.6 cm long (including anthers); **bisexual flowers**: **ovary** 4–5 × 3–4 mm, ovoid, ovary extension 10–15 mm long, (1.5–)2–3 mm diam., white, fleshy, densely villous with white to golden silky hairs; **tepals** 6, subequal, **outer tepals** 13–16 × 4.5–6 mm, elliptic-ovate with acute to bluntly acute apex, adaxially bright yellow



Fig. 5. *Curculigo elegantissima* Kiew & Škorničk. **A, B.** Habit. **C.** Upper (adaxial) side of the leaf blade. **D.** Lower (abaxial) side of the leaf blade. **E.** Detail of seeds from three various views (left); and close-up of the seed (right). From the type population *R. Kiew* & *J. Leong-Škorníčková* FRI 90776. (Photos: J. Leong-Škorníčková)



Fig. 6. *Curculigo elegantissima* Kiew & Škorničk. **A.** Young and old inflorescence. **B.** Flower (side view). **C.** Young fruits. **D.** Different stages of the inflorescences. **E.** Details of three fertile bracts, functionally male flower from the distal part of the inflorescence, functionally bisexual flower from the basal part of the inflorescence, and three fruits, one with pericarp partially removed to show the seeds. From the type population R. Kiew & J. Leong-Škorníčková FRI 90776. (Photos: J. Leong-Škorníčková)

with many (to 16) semitranslucent veins, glabrous, abaxially bright yellow, covered in long rusty hairs, denser along the centre and apex; *inner tepals* 11–14 × 6–7 mm, elliptic-ovate with acute to bluntly acute apex, adaxially bright yellow with many (to 16) semitranslucent veins, glabrous, abaxially bright yellow, less hairy than outer tepals, long hairs mainly along the basal half of the centre with margins and apex nearly glabrous; *stamens* 6, adnate to the base of tepals; *filaments* 3.5–6 mm long [measured straightened], often curved (sinuate), yellow, glabrous; *anthers* 3.5–4.5 × 1–1.3 mm, free from each other, yellow, glabrous, dehiscing throughout entire length; pollen pale yellow; *style* 8–11 mm long, yellow, glabrous; *stigma* 1–1.5 × 1–1.5 mm, subglobose, obscurely trilobed with central ostiole, yellow, finely papillate; **functionally male flowers:** *ovary* under-developed with no or very few ovules, ovary extension shorter and narrower than in basal flowers; *tepals* subequal, elliptic, smaller, semitranslucent veins fewer but more prominent than in basal flowers; *outer tepals* c. 10 × 2–3 mm; *inner tepals* c. 10 × 3 mm, indumentum similar to basal flowers; *style* and *stigma* shorter or completely missing. **Infructescence** remaining erect (not recurving), with bracts persisting. **Fruit** 11–20 × 8–11 mm (excl. rostrum), up to 30 mm long (incl. rostrum), berry-like, broadly ovoid and tapered into rostrum (beak-like persistent ovary extension, often with remnants of dried tepals at its top), white to pale greenish, villous, ripe berry altering taste to sweet; *seeds* 2–2.7 × 1.4–2 mm, many (20–40) per fruit, irregularly obovoid with a single prominent keel/raphe extending into a beak c. 0.5 mm long and with conical micropyle protruding by c. 0.3 mm at apex, seed coat dark brown to almost black, with prominently reticulate surface.

Distribution. Peninsular Malaysia, endemic to Fraser’s Hill, Pahang.

Ecology. Lower montane forest, on ridges, sometimes common on quartzite-derived soil, local but quite common, especially in more open areas along the edge of trails at c. 1300 m elevation.

Etymology. Latin, *elegans*- = graceful; *-issima* = most, so ‘most elegant’ referring to the elegant narrow, arching leaves that are rich purple-maroon underneath.

Provisional IUCN conservation assessment. This species is known from fewer than five subpopulations in Fraser’s Hill. The combined number of adult individuals in all subpopulations we have seen is less than 1000 individuals. We therefore propose to provisionally assess this species as Vulnerable (VU D1, D2) until more evidence becomes available. This species often grows close to trails, which are prone to periodic mowing of the vegetation, which negatively impacts some of the subpopulations.

Additional specimens examined. PENINSULAR MALAYSIA: **Pahang:** Hemmant Trail, 1 Jul 2020, *Aliaa-Athirah & Kiew FRI 96008* (KEP [KEP300286]); *ibidem*, 27 Aug 2020, *Sarah Nabila et al. FRI 84752* (KEP [KEP300280]); *ibidem*, 7 Nov 2023, *Aliaa-Athirah FRI 107236* (KEP [KEP300285]); Abu Suradi-Mager Trail, 30 Jul 2020, *Kiew FRI 90772* (KEP [KEP300287]); *ibidem*, 30 Jul 2020, *Kiew FRI 90773* (KEP [KEP300278]); Mager Trail, 15

Jun 2022, *Aliaa-Athirah et al.* FRI 97778 (KEP [KEP300281]); Bishop's Trail, 1 Jul 2020, *Aliaa-Athirah & Kiew* FRI 96004 (KEP [KEP300283]); along Girdle Road, 14 Jun 2022, *Aliaa-Athirah et al.* FRI 84797 (KEP [KEP300282]); ibidem, 25 Aug 2022, *Aliaa-Athirah et al.* FRI 99104 (KEP [KEP300284]).

Notes. Although widespread and common in various habitats in Southeast Asia, Hypoxidaceae is a difficult family suffering from the same fate of taxonomic confusion as many other herbaceous monocot families and genera in Southeast Asia, such as Hanguanaceae (Leong-Škorničková & Boyce, 2015; Leong-Škorničková & Niissalo, 2017). This is mainly caused by the lack of detailed descriptions and/or original material in early described species, and no consensus on the terminology and usefulness of morphological characters, especially those which could be applied in herbarium taxonomy. In *Curculigo*, in particular, the need to work on living flowering plants at different stages of the inflorescence development due to the presence of morphologically and functionally different flowers in basal and distal parts of the inflorescence, as well as ripe fruiting material and seeds, complicates matters further. As a result, in the past, the taxa have not been precisely described based on reliable discriminating characters, which previous authors such as Geerinck (1993) circumvented by recognising just a few very variable species. For Peninsular Malaysia, he recognised just three taxa, namely *Curculigo capitulata* (Lour.) Kuntze and *C. latifolia* Dryand. var. *latifolia* and var. *megacarpa* (Ridl.) Geerinck. However, at Fraser's Hill alone, at least three other *Curculigo* species await detailed study. The framework for a more systematic and standardised study of Hypoxidaceae in Southeast Asia is currently underway (Uvírová et al., in prep.) and will provide a baseline for standard terminology and methodology for measurements and description of characters. Meanwhile, here we already adopt much of this framework in the description of *C. elegantissima*.

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