

***Exacum tenue* (Gentianaceae), a new record from karst limestone in Peninsular Malaysia**

A.R. Rafidah, A.R. Ummul-Nazrah & M.A. Mohd Hairul

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

ABSTRACT. The mycoheterotrophic species, *Exacum tenue* (Blume) Klack. (Gentianaceae), was recently discovered on a limestone hill in Kelantan, Malaysia. A detailed description of the species together with a botanical drawing and colour photographs are provided.

Keywords. Kelantan, mycoheterotrophic species

Introduction

Recently we discovered a mycoheterotrophic species of *Exacum* L. (Gentianaceae) at the base of a limestone karst hill at Bukit Batu Baloh within Gua Musang District, Kelantan (Fig. 1), where it was growing in a shady area on slightly moist dense soil. The limestone hill is surrounded by oil palm and rubber plantations.

The genus *Exacum* currently comprises about 65 species (Klackenberg, 1985) with a paleotropical distribution (Klackenberg, 1985, 2002; Thulin, 2001). *Exacum* species have a wide spectrum of habitat preferences (Struwe & Albert, 2002) with most occurring in lowland and montane rainforest areas, where they usually grow in full sun (Klackenberg, 1985, 2002). All mycoheterotrophic species of *Exacum* are very rare, unprepossessing plants easily overlooked in botanical surveys and poorly represented in the world's herbarium collections (Averyanov et al., 2014). They are likely also to be ephemeral so that chance plays a part in their discovery. Mycoheterotrophic *Exacum* species can be recognised by their slender thread-like stem, tuberous roots and reduced leaves. Until now, *Exacum* has been represented in Peninsular Malaysia by only one species, *Exacum tetragonum* Roxb., recorded from Perak northwards.

Molecular investigations have shown that mycoheterotrophic *Cotylanthera* Blume species are nested within *Exacum*, resulting in the four mycoheterotrophic species being transferred to *Exacum*, namely *E. loheri* (H.Hara) Klack., *E. nanum* Klack., *E. paucisquamum* (C.B.Clarke) Klack. and *E. tenue* (Blume) Klack. (Klackenberg, 2006). None of these mycoheterotrophic species were recorded by Ridley (1923) or Turner (1997) for Peninsular Malaysia. A recent discovery of a mycoheterotrophic species identified as *Exacum tenue* using the key in Averyanov et al. (2014) is, therefore, a new record for the flora of Peninsular Malaysia. Comparison with the description of *Cotylanthera tenuis* Blume from Java (Backer & Bakhuizen, 1965) also confirms it to be this species.

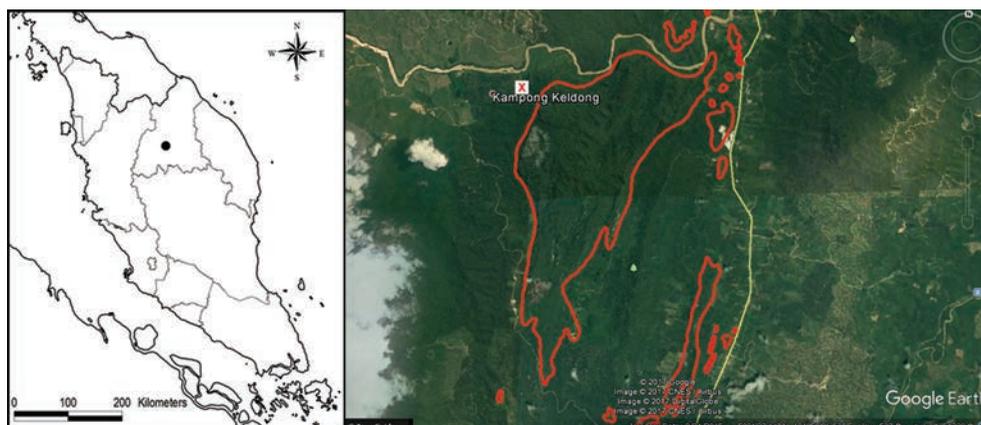


Fig. 1. Map indicating Bukit Batu Baloh, Kelantan, the collection locality of *Exacum tenue* (Blume) Klack.

The discovery of this *Exacum* species was possible due to intensified botanical exploration of the Kelantan limestone hills and further illustrates the rarity and very local distributions of many limestone species (Kiew et al., 2017).

Materials and methods

Exacum tenue was collected at the base of a karst limestone hill at Bukit Batu Baloh, Gua Musang, Kelantan ($5^{\circ}04'06.80''\text{N}$ $101^{\circ}55'25.80''\text{E}$) on 20 July 2017. Specimens were collected and preserved in Copenhagen Mixture as a spirit collection. The description is based on observations of living and spirit material and compared with type herbarium specimens and descriptions of previous collections from the literature. All dimensions given in the descriptions are from spirit collections. A photographic record was also made. The regional conservation assessment is based on the *IUCN Red List Categories and Criteria Version 3.1* (IUCN, 2012).

Taxonomy

Exacum tenue (Blume) Klack., Bot. Jahrb. Syst. 126: 47 (2006). – *Cotylanthera tenuis* Blume, Bijdr. Fl. Ned. Ind. 708 (1825); Backer & Bakhuizen, Fl. Java (Spermatoph.) 2: 438 (1965). – TYPE. Java, “Crescit: in umbrosis montis Menara”, collector unknown *s.n.* (lectotype BO *n.v.*, designated by Averyanov et al. (2014)). (Fig. 2 & 3)

Eophylon lobbii A.Gray, J. Linn. Soc., Bot. 11: 23 (1869). – TYPE. Indonesia, Java, Lobb *s.n.* (holotype K [K000912536]).

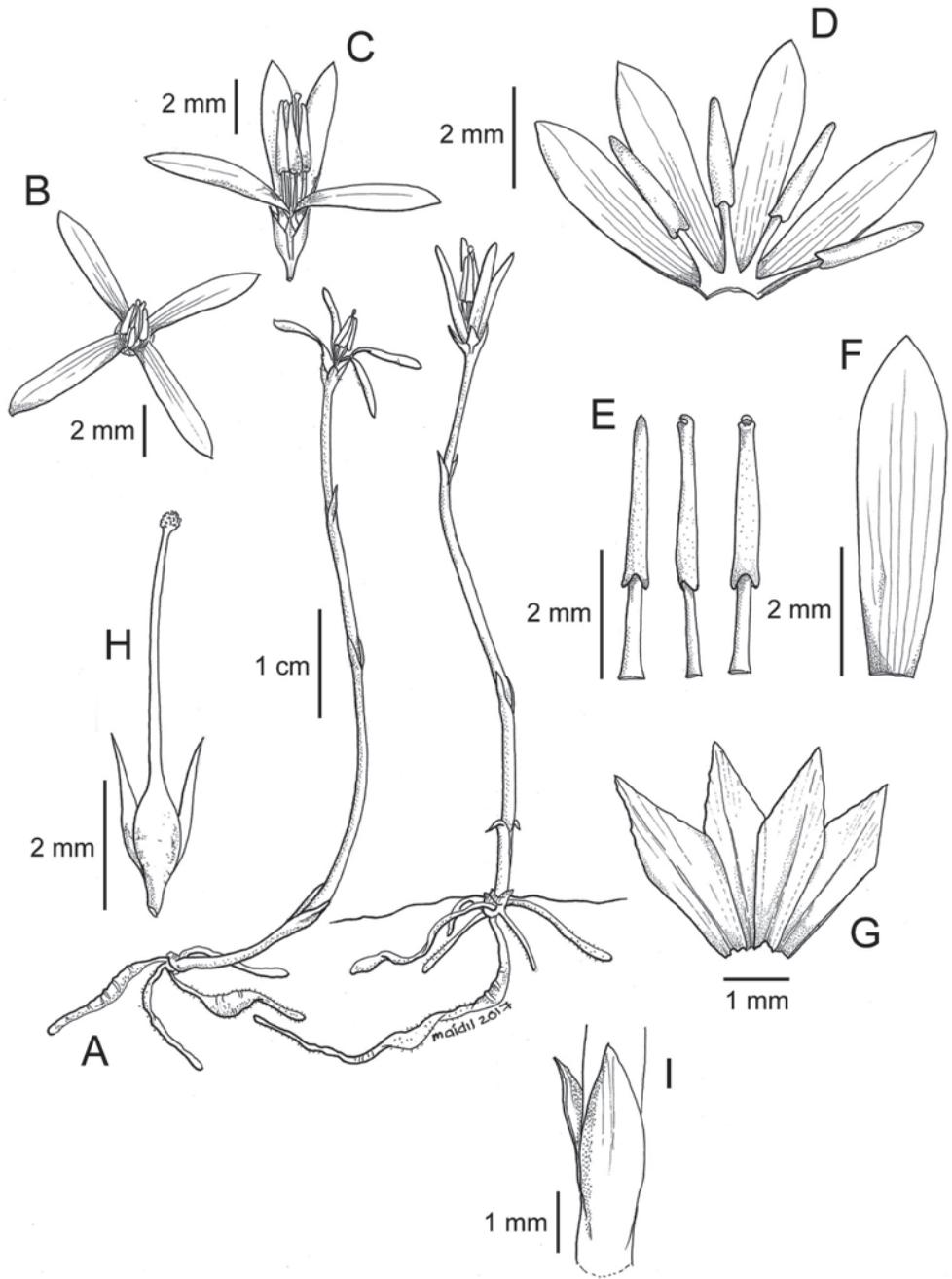


Fig. 2. *Exacum tenue* (Blume) Klack. **A.** Habit. **B.** Flower. **C.** Flower from side view. **D.** Stamens with the corolla. **E.** Stamen (abaxial, side view, adaxial view). **F.** Petal. **G.** Calyx. **H.** Pistil. **I.** Leaf-like scale. Drawn by Mohamad Aidil Noordin from Rafidah *et al.* FRI85883.

Eophylon tenellum A.Gray, J. Linn. Soc., Bot. 11: 23 (1869). – TYPE. Philippines, Mangsi Is., 1947, *Wilkes Expedition s.n.* (holotype K [K000912534]; isotype GH [00282834]).

Achlorophyllous, pure white, glabrous, mycoheterotrophic herb 4–4.5 cm tall. **Roots** clustering, moniliform, fleshy. **Stem** erect, slender, glabrous, unbranched, terete, 1–2 mm in diameter. **Leaves** opposite, reduced to scales; internodes 1–1.5 cm long. **Flower** terminal, solitary, 4-merous, symmetric, pure white. **Calyx** 4-lobed, basally fused, c. 2 mm long, fleshy, rhomboid-shaped, acute. **Corolla** 4-lobed, to 5.8 mm long, deeply divided, tube very short, globular, less than 1 mm long, lobes erect to spreading/patent, c. 4.8 mm long, up to 1.3 mm wide, narrowly oblong, entire, apex apiculate. **Stamens** 4, inserted in throat of corolla tube between corolla lobes, filaments white, to 1.3 mm long, terete, shorter than anthers, anthers bright yellow, to 2.5 mm long, opening by a single apical pore, recurved inwards, introrse, dorsifixed, narrowly sagittate, wide at base and slightly narrow to the apex. **Ovary** with a very thin wall; carpels 2, each unilocular, globular, to 1 mm in diam., style c. 5 mm long, filiform, stigma capitate. **Fruit** not seen.

Distribution. Previously recorded in India, Indonesia (Sumatra, Java, Kalimantan, Sulawesi, and Western New Guinea), the Philippines, and Papua New Guinea. In Peninsular Malaysia it is a new record.

Ecology & habitat. The population was small, about 5–6 individuals in one patch, growing on a thick leaf litter layer over dense moist limestone derived soil, fully shaded under the tree canopy at the base of a limestone hill. On revisiting the same site two months later, no plants could be found, suggesting it is an ephemeral species.

Phenology. Collected once in flower in July 2017.

Provisional IUCN conservation assessment. Critically Endangered CR B2ab(ii,iii). In Peninsular Malaysia, it is known from one locality, which is not protected. None of the limestone hills in Kelantan fall within the network of Totally Protected Areas except a few small outcrops within the National Park (Taman Negara). In addition, its habitat at the base of the limestone hill is threatened by disturbance associated with the surrounding oil palm plantations.

Specimen examined. PENINSULAR MALAYSIA: **Kelantan:** Gua Musang, Batu Baloh, 20 Jul 2017, *Rafidah et al.* FRI 85883 (KEP).

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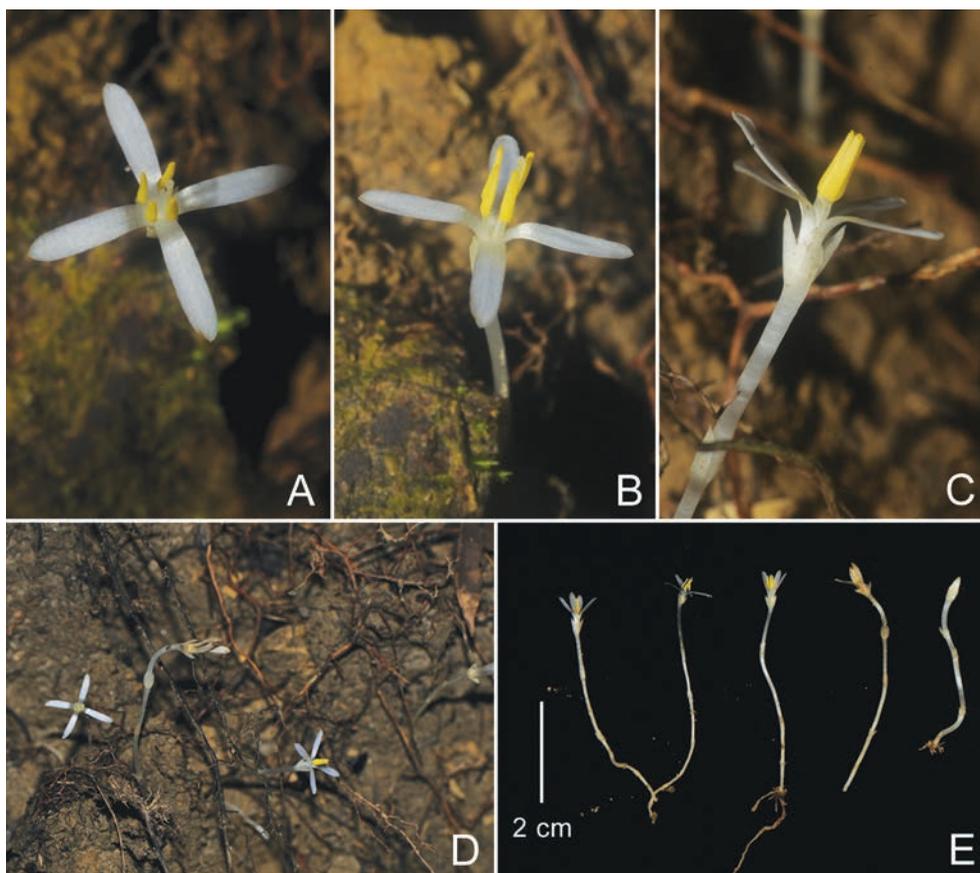


Fig. 3. *Exacum tenue* (Blume) Klack. **A.** Detail of flower (top view). **B.** Detail of flower (semi-side view). **C.** Detail of plant (side view). **D.** Habit. **E.** Plants in side view. (Photos: A–D, A.R. Rafidah; E, A.R. Ummul-Nazrah)

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References

- Averyvanov, L.V., Nguyen, K.S. & Nguyen, H.T. (2014). Checklist of mycoheterotrophic species of the genus *Exacum* (Gentianaceae) and new species, *Exacum zigomorpha*, from northern Vietnam. *Phytotaxa* 183(2): 108–113.

- Backer, C.A. & Bakhuizen van der Brink, R.C. (1965). Gentianaceae. In: *Flora of Java*, vol. 2, pp. 437–441. Groningen: Wolters-Noordhoff.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*, 2nd ed. Gland, Switzerland and Cambridge, UK: IUCN.
- Kiew, R., Rafidah, A.R., Ong, P.T. & Ummul-Nazrah, A.R. (2017). Rare Limestone Plants in Peninsular Malaysia - What are they, where do they grow and how to conserve them. *Malayan Naturalist* 71(1): 33–41.
- Klackenberg, J. (1985). The genus *Exacum* (Gentianaceae). *Opera Bot.* 84: 1–144.
- Klackenberg, J. (2002). Tribe Exaceae. In: Struwe, L. & Albert, V.A. (eds) *Gentianaceae: Systematics and natural history*, pp. 66–108. Cambridge: Cambridge University Press.
- Klackenberg, J. (2006). *Cotylanthera* transferred to *Exacum* (Gentianaceae). *Bot. Jahrb. Syst.* 126: 477–481.
- Ridley, H.N. (1923). *The Flora of the Malay Peninsula*, vol. 2. London: L. Reeve & Co.
- Struwe, L. & Albert, V.A. (2002). *Gentianaceae: Systematics and natural history*. Cambridge: Cambridge University Press.
- Thulin, M. (2001). *Exacum* (Gentianaceae) on the Arabian Peninsula and Socotra. *Nord. J. Bot.* 21: 243–247.
- Turner, I.M. (1997 [‘1995’]). A catalogue of the vascular plants of Malaya. *Gard. Bull. Singapore* 47: 1–757.