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

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A new species of *Epirixanthes* (Polygalaceae) from Imbak Canyon, Sabah, Borneo

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Abstract

The mycoheterotrophic genus *Epirixanthes* Blume is a small genus of Polygalaceae. Here, we describe a new species of *Epirixanthes*, *E. confusa* Tsukaya, M. Suleiman & H. Okada, discovered in the mostly unexplored Imbak Canyon, Sabah, Borneo. Along with photographs and illustrations of this new species, a revised key to the genus is presented.

Keywords: Borneo, *Epirixanthes*, Imbak Canyon, Malaysia, mycoheterotrophic plant, Polygalaceae, Sabah

Introduction

Borneo is one of the richest areas for biodiversity in the world, in particular with respect to mycoheterotrophs, and our recent botanical explorations in Borneo revealed many previously undescribed mycoheterotrophic species (e.g., Tsukaya *et al.* 2011, 2014; Tsukaya and Okada 2005, 2012a, b, c, 2013a,b, Tsukaya and Suetsugu 2014). In 2015, we conducted a botanical survey in the Imbak Canyon, Sabah, Borneo, located near the Maliau Basin Conservation Area and Datum Valley Conservation Area. The Imbak Canyon Conservation Area (ICCA) is characterized by a valley between sandstone ridges—including Gunung Kuli, the highest mountain in the ICCA—and covers approximately 30,000 ha. Few botanical explorations have previously been performed in this area. During the survey described herein, we encountered a species of *Epirixanthes* Blume, which resembles the most common species of the genus *E. elongata* Blume (1823:82), in having pointed inflorescence apices and a similar overall size, but clearly distinguished by having persistent bracts.

The genus *Epirixanthes* is a small genus of six mycoheterotrophic species (Pendry 2010), among which the most widespread is *E. elongata*, distributed from eastern India to south China, and all over Malesia. Borneo represents the area in which the biodiversity of this genus is most pronounced. Five of the six species of *Epirixanthes* are found in Borneo, with the exception of *E. compressa* Pendry 2010: 184. According to Pendry (2010), the members of this genus can be largely divided into two groups based on whether their bracts are caducous (*E. elongata* and *E. pallida* Wendt 1988: 492) or persistent until or after fruit maturation (*E. papuana* J.J.Sm. 1912: 286, *E. cylindrica* Blume 1823: 82, *E. compressa*, and *E. kinabaluensis* Wendt 1988: 491). The latter group can be divided according to the presence (*E. papuana*) or absence (the remaining three species) of bracteoles. The newly discovered specimen from ICCA apparently belongs to the latter group without bracteoles, but differs from *E. papuana*, *E. cylindrica*, and *E. kinabaluensis* in having acutish inflorescence apices. It also differs from *E. compressa* in having slightly longer bracts, which are also persistent even after fruit maturation. Here, we describe this new species with a revised key to the species of the genus.

Materials and Methods

The structure of the entire plant was observed under a stereomicroscope (MZ16a; Leica Microsystems, Cambridge, UK). Drawings were prepared by K. Hamasaki with the aid of a microscope equipped with a camera lucida. The specimens were compared with herbarium specimens of *Epirixanthes* species deposited at the University of Tokyo (TI), Japan, and the Herbarium Bogoriense (BO), Indonesia, and with descriptions in the literature.

Results

Taxonomic Treatment

Epirixanthes confusa Tsukaya, M. Suleiman & H. Okada, sp. nov. (Figs. 1, 2)

Epirixanthes confusa differs from the other members of *Epirixanthes* in having the following features: persistent bracts even after fruit maturation, no bracteole, and pointed inflorescence apices.

Type—Malaysia. Sabah: Imbak Canyon Conservation Area, along the Ridge Trail, alt. 622 m, 05°01.099'N, 117°01.774'E, 9 August 2015, Tsukaya, H. Okada, H., Hayashi, T. & Suleiman, M., No. TOH-07 (Holo- BORH, iso- TI, KYO).

Erect mycoheterotrophic herb, 40–120 mm tall. *Roots* filamentous, branched. *Stems* reddish purple, branched, glabrous (rarely and scarcely having hairs). *Leaves* reduced to scale-like organs, 1.5–2.5 mm long, apex acute, glabrous. *Shoots* terminating in inflorescence, *inflorescence* spike, acutish at apex, 2.0–4.5 cm (to >6.0 cm) long, 2.0–2.5 mm thick, brownish ivory. *Flowers* dense, ivory (or white), ca. 2 mm long. *Bracts* purple-brownish ivory, linear-lanceolate, acuminate, longer than the flower bud, 1.0–1.5 mm long, persistent. *Sepals* 5, having fine serrations along the margin, ovate-lanceolate, ca. 1.8 mm long, persistent. *Petals* 3, connate at base, middle lobe boat-shaped, obcordate, divided into two lobes at the tip. *Stamens* 5, filaments united, adnate at base to corolla. *Ovary* 2-locular, style straight or apically slightly curved upwards, stigma slightly 2-lobed. *Fruit* capsule, emarginate, enclosed in the sepals and bracts. Seeds, ca. 0.5 mm.

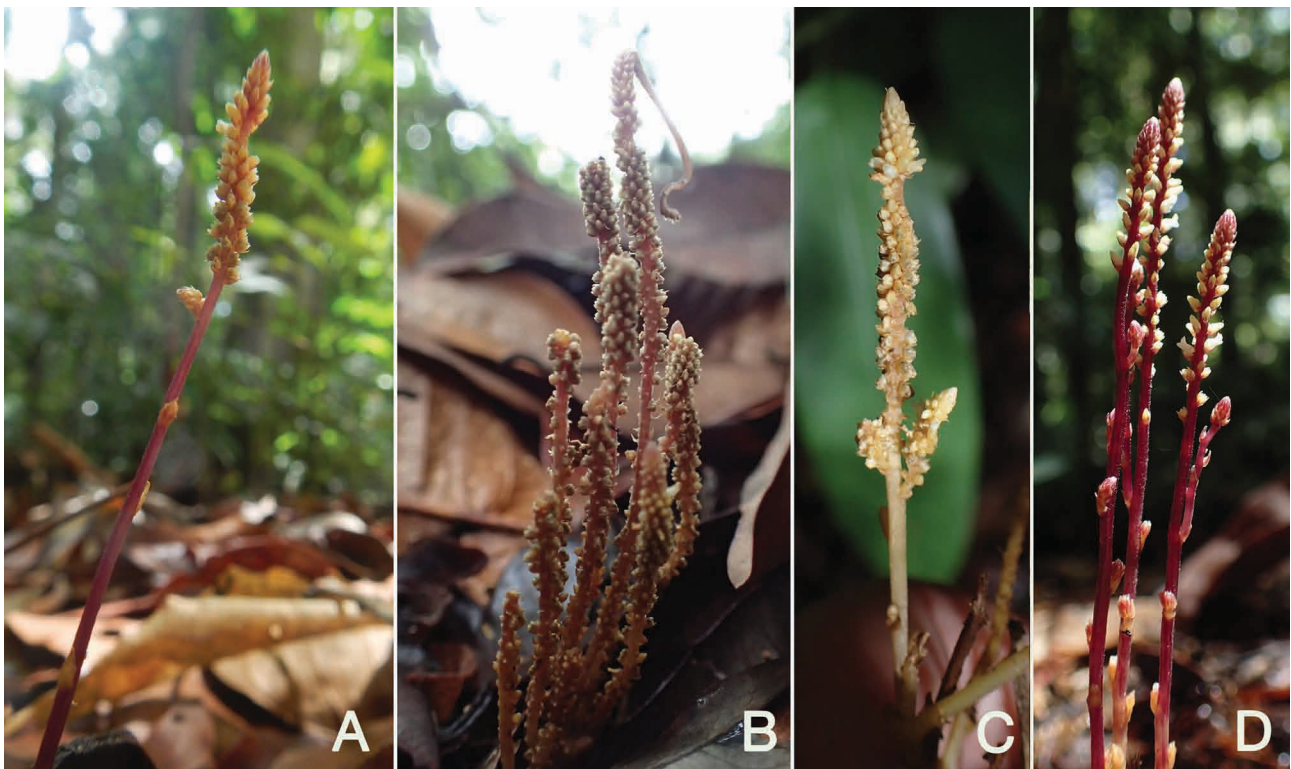


FIGURE 1. *Epirixanthes confusa* Tsukaya, M. Suleiman & H. Okada in its native habitat, in comparison with *E. elongata*. (A,B) Young (A) and mature (B) inflorescences. Note the persistent bracts. (C) Albino form of *E. confusa*. (D) Flowering individual of *E. elongata*. Note caducous bracts, sparse inflorescence and hairs on stems. Photographs were taken in Imbak Canyon Conservation Area, on 8 August, 2015 (A) and 9 August, 2015 (B, C); in Betung-Kerihun National park, West Kalimantan, on 7 May, 2016.

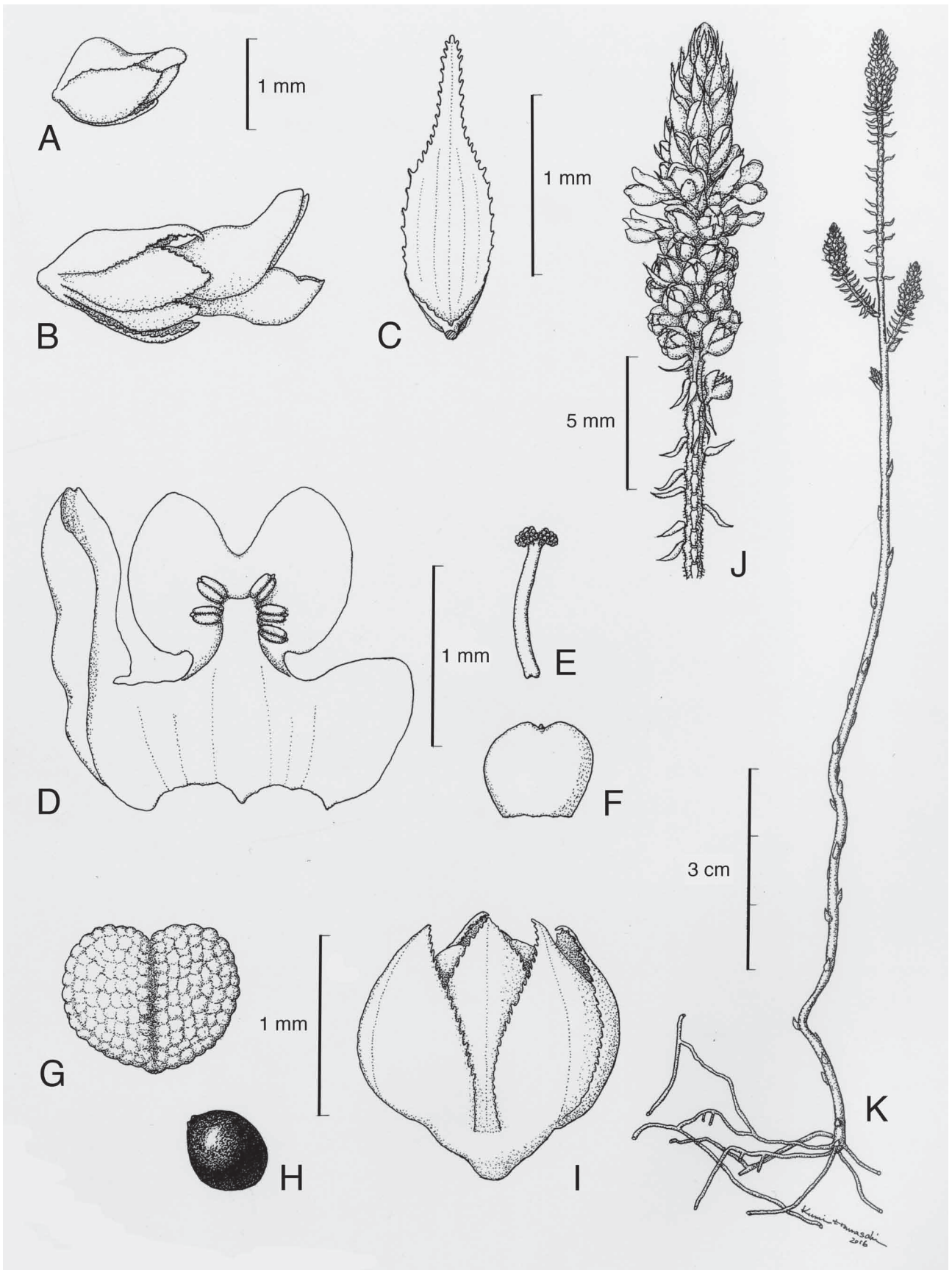


FIGURE 2. Morphology of *Epirixanthes confusa* Tsukaya, M. Suleiman & H. Okada.

A, Lateral view of a floral bud. B, Lateral view of a flower. C, Bract. D, Petals with stamens. Five anthers are usually arranged at the tip. E, Stigma and style. Stigma is slightly 2-lobed. F, Ovary. G, Mature fruit. H, Seed. I, Mature fruit with persistent sepals. J, Inflorescence. K, Flowering individual. Drawing by Ms. Kumi Hamasaki.

Distribution—Found in the understories of dipterocarp forest, in particular along ridges. At present, *E. confusa* is known to occur only in Imbak Canyon, Sabah, Borneo. However, our preliminary surveys on herbarium specimens deposited in BO suggested that some specimens collected from Java, Indonesia, annotated as “*E. elongata*”, are actually *E. confusa* (for example, BO-1791084, BO-1794915, BO-1794902, BO-1478688, BO-1478690, BO-1794913 and BO-1794910). Because *E. confusa* is easily mis-identified as *E. elongata*, detailed re-examinations of herbarium specimens are required to reveal its whole distribution.

Diagnostis characters—*Epirixanthes confusa* resembles *E. elongata* in having a slender stature. Excluding *E. elongata* and *E. confusa*, all other *Epirixanthes* species show thick and round-headed inflorescences, and it is easy to distinguish them from *E. elongata* and *E. confusa*, which share acutish inflorescence tips. *E. compressa* also has a pointed inflorescence head (Pendry, 2010), but shows abrupt changes in inflorescence thickness/diameter between zones in immature flower buds and in flowers, while *E. elongata* and *E. confusa* show smooth, gradual, and smaller size transitions, with respect to the diameter of inflorescences, from immature flower buds to flowers. The overall morphology is similar between *E. elongata* and *E. confusa*, but the presence of persistent bracts in the latter species is a clear distinguishing feature. Internodes between fruits do not elongate in *E. confusa*, giving an impression that the inflorescence at the fruiting stage seems to be denser than in *E. elongata*, where internodes between fruits elongate. The glabrous leaves also distinguish *E. confusa* from *E. elongata* that has pilose leaves (Table 1).

TABLE 1. Morphological comparisons between *Eirixanthes elongata* and *E. confusa*.

| | <i>E. elongata</i> | <i>E. confusa</i> |
|---------------|-----------------------------------|------------------------------------|
| Bracts | caducous before the flowers open | persistent until the fruits mature |
| Leaves | pilose | glabrous |
| Inflorescence | internode elongate at fruit stage | dense even at fruit stage |

Etymology—The species name *E. confusa* denotes the confusion between this species and *E. elongata*.

Additional specimen examined—Malaysia. Sabah: Imbak Canyon Conservation Area, from Kuli Station (N05°06'48"; E117°02'25", alt. 312 m) to Kuli Water Fall (N05°00'344"; E117°03'208") alt. 440 m. 8 August, 2015. Tsukaya, H. Okada, H., Hayashi, T. & Suleiman, M., No. TOH-06 (BORH).

Key to the species of *Epirixanthes* modified from Meijden (1988) and Pendry (2010)

1. Inflorescence acutish at apex.
2. Bracts caducous before the flowers are fully developed..... *E. elongata* Blume
2. Bracts persistent at least until the fruits are mature..... *E. confusa* Tsukaya, M. Suleiman & H. Okada
1. Inflorescence: dense and round-headed.
3. Bracts caducous before the flowers are fully developed..... *E. pallida* Wendt
3. Bracts persistent at least until the fruits are mature.
4. Flowers subtended by a bract and pair of bracteoles. Fruits fully enclosed by the sepals..... *E. papuana* J.J.Sm.
4. Flowers subtended by a bract and bracteoles absent. Fruits not fully enclosed by the sepals with the apex exposed.
5. Bracts elliptic to obovate, imbricately covering the flower buds..... *E. cylindrica* Blume
5. Bracts lanceolate, not fully covering the flower buds.
6. Inflorescence apices pointed; bracts 1–1.5 mm long, not persistence after the fruits have been shed..... *E. compressa* Pendry
6. Inflorescence apices round; bracts 2–2.5 mm long, persistence after the fruits have been shed..... *E. kinabaluensis* Wendt

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