

Arisaema brinchangense Y.W. Low, Scherberich & Gusman (Araceae), a new threatened species endemic to the Cameron Highlands (Peninsular Malaysia)

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Abstract

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Arisaema brinchangense Y.W. Low, Scherberich & Gusman (Araceae) is described as new and illustrated. The new species is similar to *Arisaema anomalum* Hemsl. but differs by the morphology of its spathe. It is placed under *Arisaema* sect. *Anomalum* Gusman & L. Gusman based on morphological and growth characters, the latter observed in the field and unique to that section. *Arisaema brinchangense* is endemic to the Cameron Highlands, Pahang, Peninsular Malaysia, and is assessed as “Critically Endangered” following IUCN Red List Categories and Criteria due to habitat loss.

Keywords

ARACEAE – *Arisaema* – Peninsular Malaysia – Cameron Highlands – Taxonomy – New species

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Introduction

Arisaema Mart. (Araceae), otherwise known as cobra-lily or jack-in-the-pulpit is a widespread group of herbaceous plants occurring in North America, East Africa, the Arabian Peninsula, Southwest India to Sri Lanka, the Sino-Himalayas through to the Sino-Japanese regions, Indochina and Malesia, with the Sino-Himalayan and Sino-Japanese regions being the centre of its diversity. At present, between 170–200 species are estimated occurring worldwide (MAYO et al., 1997; GUSMAN & GUSMAN, 2006; MABBERLEY, 2008; BOYCE & WONG, 2015; GOVAERTS et al., 2016). The Peninsular Malaysian *Arisaema* were first reviewed by RIDLEY (1925) and updated recently by MANSOR et al. (2011). Presently, only seven taxa are enumerated for Peninsular Malaysia, namely, *A. anomalum* Hemsl., *A. filiforme* (Reinw.) Blume, *A. fimbriatum* Mast. subsp. *fimbriatum*, *A. laminatum* Blume, *A. roxburghii* Kunth, *A. scortechinii* Hook.f. and *A. wrayi* Hemsl., of which two, *A. anomalum* and *A. scortechinii* are endemic (RIDLEY 1907, 1925; HAY et al., 1995; GUSMAN & GUSMAN, 2006; MANSOR et al., 2011). Furthermore, these seven taxa were grouped into two sections, namely *Arisaema* sect. *Anomalum* Gusman & L. Gusman, and *Arisaema* sect. *Fimbriata* (Engl.) J. Murata. The latter consists of *A. fimbriatum* subsp. *fimbriatum*, *A. laminatum* and *A. roxburghii*; while the former includes *A. anomalum*, *A. filiforme*, *A. scortechinii* and *A. wrayi* (GUSMAN & GUSMAN, 2006).

One of the oldest hill stations in Peninsular Malaysia is the Cameron Highlands, and it is located on the northwestern part of Pahang between 1000–2091 m (AIKEN, 1994). The Cameron Highlands is a popular tourist destination famed for its cool weather, picturesque tea estates, and highland produce. Owing to its popularity for tourism and the importance for agriculture and floriculture industries in Malaysia, the pristine cloud forest of the Cameron Highlands is under immense pressure for exploitation. At present the highland is facing numerous environmental issues such as severe soil erosion, landslides, siltation and pollution of highland streams, and floods (MIDMORE et al., 1996; FREEMAN, 1999; THE STAR, 2012; THE SUN DAILY, 2014).

In 2008, a peculiar *Arisaema* with a pale-coloured inflorescence and distinctive markings on the spathe-limb was encountered at about 2000 m in the mossy forest of Mount Brinchang, Cameron Highlands by the second author while on a botanical excursion organised by the Universiti Kebangsaan Malaysia. In 2010, a flowering specimen of the same *Arisaema* species was examined by the first author beside the road leading towards the summit of Mount Brinchang. This unusual *Arisaema* was subsequently encountered again by the first author in 2012 and 2014 around the same locality, prompting a formal investigation into its identity. The Mount Brinchang *Arisaema* is closely similar to *A. anomalum*, but differing by a suite of morphological characteristics that distinguish these two taxa apart. Hence, we consider this taxon from Mount Brinchang to be distinct and formally described here as

new. So far, this new species is only known from the Cameron Highlands, and is assessed as “Critically Endangered” following the IUCN Red List Categories and Criteria (IUCN, 2012).

Materials and Methods

A review of all the Malayan *Arisaema* species was conducted based on herbarium specimens preserved in KLU and SING. Conventional methods of herbarium taxonomy were applied. Type materials present at SING were examined, as well as type images of all Malayan *Arisaema* species available at JSTOR Global Plants website [http://plants.jstor.org]. Botanical terms used in this study largely follows BEENTJE (2012), while technical terms pertinent to *Arisaema* description follows GUSMAN & GUSMAN (2006).

A preliminary risk of extinction assessment was made using IUCN Red List Categories and Criteria (IUCN, 2012). The extent of occurrence (EOO) and the area of occupancy (AOO) were calculated using GeoCAT (BACHMAN et al., 2011). Data used for the assessment were based on herbarium records at KLU and SING.

Key to *Arisaema* taxa of Peninsular Malaysia

1. Subterranean stem a subglobose tuber (up to 3.5 cm in length, 1–5 cm wide) [sect. *Fimbriata*] 2
 - 1a. Subterranean stem an elongated rhizome (up to 15 cm long) [sect. *Anomalum*] 4
2. Spadix-appendix long and whip-like (8–15 cm long) exceeding the spathe-limb *A. fimbriatum* subsp. *fimbriatum*
- 2a. Spadix-appendix short (3–5 cm long) not exceeding the spathe-limb 3
3. Spathe-limb inside white at base, vivid green from the apex to the basal white portion with a thin dark purple band separating the vivid green and white zones *A. laminatum*
- 3a. Spathe-limb inside pale yellow or pale green, sometimes suffused with purple *A. roxburghii*
4. Spadix-appendix short (2–5 cm long) 5
 - 4a. Spadix-appendix long (10–35 cm long) 7
5. Leaf pedate, with 5–7 leaflets *A. scortechinii*
 - 5a. Leaf trifoliolate 6
6. Spathe-tube mouth margin strongly recurved (auriculate; auricles 5–10 mm wide) *A. anomalum*
 - 6a. Spathe-tube mouth margin straight and hardly recurved (not auriculate) *A. brinchangense*
7. Leaf with 3–5 leaflets, leaflets linear-elliptic *A. filiforme*
 - 7a. Leaf with 7–9 leaflets, leaflets elliptic *A. wrayi*

Taxonomy

Arisaema brinchangense Y.W. Low, Scherberich & Gusman, *spec. nova* (Fig. 1; 2A, B).

Typus: MALAYSIA. Pahang (Peninsular Malaysia): Cameron Highlands, Mt. Brinchang, beside road leading towards the observation tower, c. 2000 m, 10.XI.2012, *Low & Low-Edwin LYW 520* (holo-: SING [SING0166277 including spirit material, SING0202906]!; iso-: BR!, G!, KLU!, LYJB!).

Arisaema brinchangense Y.W. Low, Scherberich & Gusman is morphologically close to *A. anomalum* Hemsl. but differs by having spathe-tube mouth margin straight and hardly recurved (not auriculate) (vs. strongly recurved (auriculate) in *A. anomalum*), and a distinctive white or pale cream coloured marking somewhat resembling a trident (with 3–6 pointed tips) around the mid-portion of the spathe-limb (vs. 9–10 longitudinal stripes parallel along the spathe-tube).

Terrestrial perennial evergreen herb, to 40(–60) cm tall. Rhizome to 7 cm long and 0.7–1.7 cm wide, carmine; roots numerous, 1–3 mm wide, cream to apricot. Pseudostem absent. Cataphylls to 3, c. 1–9 cm long, carmine with longitudinal darker stripes. Leaf 1(–2). Petiole cylindrical, c. 19–29 cm long, c. 3–5 mm wide at the base, dull carmine to claret, without any markings. Leaf blade trifoliate; leaflets glossy apple green on both sides, paler below, membranaceous; apex acuminate ending in an arista about 0.7–1 cm long; base cuneate to obtuse; margin entire; midrib prominent and glabrous on both sides; secondary veins 9–12 pairs, making an angle of 30–50° with the midrib and joining to form a distinct marginal vein, slightly sunken and glabrous on upper side, slightly raised to prominent and glabrous on lower side; marginal vein approximately 2–5 mm from margin; tertiary venation flat on both sides. Central leaflet elliptic-ovate, 9–17 cm long, 3–6.6 cm wide, petiolulate; petiole c. 1.8–2.7 cm long; blade symmetrical. Lateral leaflets ovate to elliptic-ovate, 10.5–15.7 cm long, 3.5–5 cm wide, petiolulate; petiole c. 0.5–1.8 cm long; blade asymmetrical. Inflorescence overtopping the leaves. Peduncle 23.5–35 cm long, similar in colour to petiole from the base upwards, fading gradually to white towards the inflorescence. Spathe-tube cylindrical or slightly funnel-shaped, 3.7–5.5 cm long, 0.4–0.9 cm wide at base, widening to 1–2.5 cm at the mouth, green to pale dull green with a thick white band on outer and inner dorsal side, white-waxy outside, white at base; mouth-margins straight and hardly recurved (not auriculate). Spathe-limb horizontal, lanceolate, c. 4.5–6.5 cm long and 1.3–2.5 cm wide, similar in colour to the tube, but darker. Spathe-tip caudate, ending with a thread c. 0.5–1.3 cm long. Spadix-appendix c. 3–4.8 cm long, c. 2–3.2 cm exerted from the tube, but not exceeding the spathe-limb, sessile, protruding portion bent forward to slightly

down-curved, blunt at apex, 2–4 mm wide at base tapering gradually towards the apex, green to carmine, glabrous above the fertile portion or with a few upcurved neuters. Spadix fertile zone male or bisexual. Male fertile zone cylindrical, c. 4.2 cm long and c. 3–4 mm across; synandria loosely arranged, pale pink to carmine, 4–6-anded, thecae dehiscent by an elongated pore, borne on a pale pink to carmine stalk, pollen white. Female fertile zone c. 2.5 cm long and c. 3–4 mm across; pistils densely arranged; ovaries ovoid, vivid green, c. 2.5–4 mm wide, with a whitish stigma on a short green style.

Etymology. – The species epithet refers to Mount Brinchang (2031 m), where the type specimen was collected.

Distribution and Habitat. – *Arisaema brinchangense* is so far known only from around the summit of Mount Brinchang, Cameron Highlands (Fig. 3) where it grows in the montane forest c. 2000 m on moist forest floor covered with thick organic litter under deep to semi-shaded condition.

Phenology. – This species has been collected in flower in September and November. However, this may not necessarily reflect a clear flowering period as climate of Cameron Highlands is quite constant throughout the year. Fruiting period unknown.

Conservation status. – *Arisaema brinchangense* is so far known only from the Cameron Highlands where recent discoveries were mostly around the summit of Mount Brinchang, protected within the Batu Gangan Permanent Forest Reserve. Otherwise, no further recent observations were made elsewhere apart from the two historical collections at a much lower elevation around Sungai Bertam near the golf course. The extent of occurrence (EOO) of the species is estimated to be 0.010 km², whereas its area of occupancy (AOO) is estimated to be 8 km². Major conservation concern for the species is habitat loss due to exploitation for agriculture and floriculture industries that have increased tremendously since its inception during the colonial times in the early 20th century. Illegal land clearing for farming activities is a major concern as local authority estimated about 6000 ha of land were encroached illegally (NEW STRAITS TIMES, 2014). *Arisaema brinchangense* should thus be assigned a preliminary conservation status of “Critically Endangered” [CR B1ab(iii,iv)+2ab(iii,iv)]. This preliminary conservation status would require reassessment as more botanical surveys in Peninsular Malaysia are being carried out under the “Flora of Peninsular Malaysia programme”.

Notes. – *Arisaema brinchangense* is an evergreen species that has rhizomatous underground stem with roots generally growing out from all over the rhizome. Besides that, it also



Fig. 1. – *Arisaema brinchangense* Y.W. Low, Scherberich & Gusman. **A.** Habit; **B.** Details of the lower leaf blade surface; **C.** Rhizome showing numerous offsets and fleshy white roots, inflorescence artificially removed; **D.** Front view of an inflorescence showing spathe-limb with distinctive white trident marking (with three pointed tips) and spadix-appendix slight bent forward; **E.** Spathe-tube of a male inflorescence artificially removed to show the male spadix fertile zone, note pollen accumulated at the base of the tube.

[Low & Low-Edwin LYW 520, SING] [Photos: Y.W. Low]



Fig. 2. – Inflorescences of *Arisaema brinchangense* Y.W. Low, Scherberich & Gusman (**A-B**) and *A. anomalum* Hemsl. (**C-D**). **A.** Side view of the inflorescence showing straight and hardly recurved spathe-tube mouth margin; **B.** Dorsal view of the inflorescence showing distinct white to pale cream coloured trident marking (with three pointed tips) on the spathe-limb; **C.** Side view of an inflorescence showing strongly recurved (auriculate) spathe-tube mouth margin; **D.** Dorsal view of the inflorescence showing white to pale cream coloured narrow parallel stripes along the spathe-limb. [Photos: D. Scherberich]

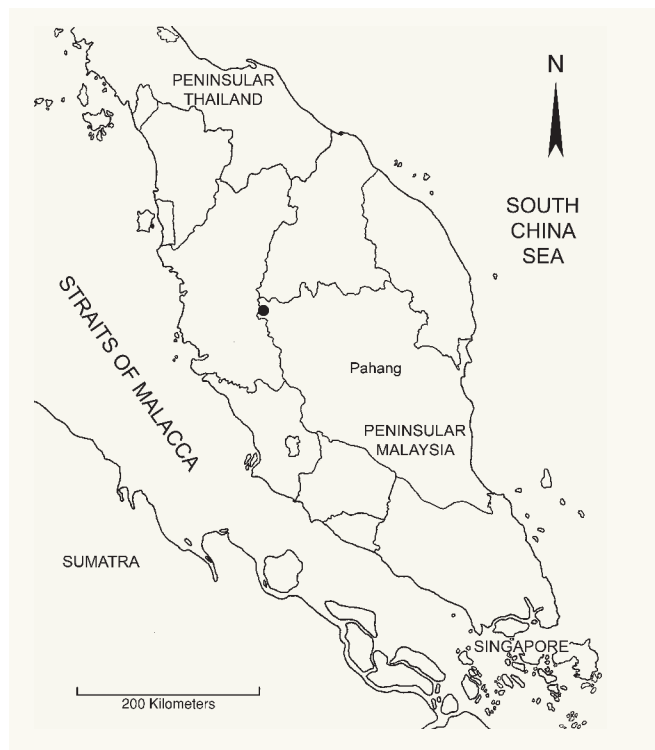


Fig. 3. – Distribution of *Arisaema brinchangense* Y.W. Low, Scherberich & Gusman (black circle) in Peninsular Malaysia.

has (i) leaves and inflorescences emerging separately from the rhizome each wrapped in their own cataphylls; (ii) new leaves emerge when old leaves are still present; (iii) spadix-appendix slightly exerted from the spathe-tube; (iv) neuters present above the fertile portion of the spadix; and (v) free flowering. All these characters possessed by *A. brinchangense* placed it in *Arisaema* sect. *Anomalum* as defined by GUSMAN & GUSMAN (2006). At present, there are five species of *Arisaema* sect. *Anomalum* recorded for Peninsular Malaysia, namely *Arisaema anomalum*, *A. brinchangense*, *A. filiforme*, *A. scortechinii*, and *A. wrayi*, of which all have strongly recurved (auriculate) spathe-tube mouth margin except *A. brinchangense*.

Arisaema brinchangense differs from *A. anomalum* in having straight and hardly recurved (not auriculate) spathe-tube mouth margin, and distinctive white to pale cream coloured marking somewhat resembling a trident (with 3-6 pointed tips) around the mid-portion of the spathe-limb (Fig. 2A, B). In contrast, *A. anomalum* has strongly recurved (auriculate) spathe-tube mouth margin, and 9-10 longitudinal stripes parallel along the spathe-tube (Fig. 2C, D). Besides that, these two taxa also differ in a suite of morphological characters largely observed in inflorescence that distinguishes them apart (see Table 1). It is important to note that these two taxa are difficult to tell apart in the field or on herbarium sheet when they are sterile.

Paratypi. – MALAYSIA. Pahang (Peninsular Malaysia): Cameron Highlands, around the Green Cow Tavern (following VAN STEENIS-KRUSEMAN, 1950), XI.1939-I.1940, fl., *Batten Pooll* s.n. (SING [2 sheets]); Cameron Highlands, Sg. Uruil, below golf course, 1463 m [4800 ft], 2.IX.1956, fl., *Burkill HMB 820* (SING).

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Table 1. – Comparison of morphological characteristics, distribution and habitat between *Arisaema anomalum* Hemsl. and *A. brinchangense* Y.W. Low, Scherberich & Gusman.

Characters	<i>A. anomalum</i>	<i>A. brinchangense</i>
Rhizome length [cm]	c. 15	c. 7
Spathe-limb, surface markings	Spathe-limb with numerous somewhat evenly spaced white or pale cream coloured narrow stripes running parallel along the length from around the apex to the base	Spathe-limb with a distinctive white to pale cream coloured marking somewhat resembling a trident (with 3-6 pointed tips) around the mid-portion
Spathe-tube, colour	Dark carmine	Green to pale dull green
Spathe-tube, mouth margin	Strongly recurved (auriculate), auricles 5-10 mm wide and 15 mm long	Straight and hardly recurved (not auriculate)
Anthers, dehiscence	Rounded pores	Oblong pores
Distribution	Endemic to Peninsular Malaysia. Occurring in Perak (Bukit Larut [Maxwell Hill]) and Pahang (Cameron Highlands and Mount Mengkuang Lebar)	Endemic to Peninsular Malaysia. Known only from Cameron Highlands, Pahang
Habitat	Hill to upper dipterocarp forest occurring from 600-1000 m	Montane forest occurring c. 2000 m

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