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Kaempferia subgen. *Protanthium* (Zingiberaceae) in Myanmar: A New Species, a New Record of *K. simaoensis* Y.Y.Qian, and Reinstatement of *K. parishii* Hook.f. †

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Abstract

The taxonomy and distribution of *Kaempferia* subgen. *Protanthium* (Zingiberaceae) in Myanmar remain incompletely documented despite the botanical significance of the region. This study aims to clarify the diversity and taxonomic status of species belonging to this subgenus in Myanmar through field investigations and herbarium studies. Detailed morphological examinations of newly collected and previously documented specimens were conducted to evaluate diagnostic characters and species delimitation. As a result, *Kaempferia kayinensis* is described in this paper as a new species from Kayin State, southeastern Myanmar, and *K. simaoensis* Y.Y.Qian as a new country record. In addition, the taxonomic status of *K. parishii* Hook.f. is reassessed and reinstated based on morphological evidence, distinguishing it from *K. ovalifolia* Roxb. These findings confirm the presence of four species of *Kaempferia* subgen. *Protanthium* in Myanmar (*K. kayinensis*, *K. parishii*, *K. rotunda*, and *K. simaoensis*) and increase the number of known *Kaempferia* species in the country to twelve. The results highlight the importance of continued floristic and taxonomic studies to better document the diversity of *Kaempferia* in Myanmar.

Keywords: *Kaempferia*; Myanmar; new record; new species; *Protanthium*; taxonomy; Zingiberales

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1. Introduction

The genus *Kaempferia* L. (family Zingiberaceae) comprises a group of low-growing, rhizomatous herbs native to tropical and subtropical Asia [1–5]. These species are well known for their distinctive floral structures, fragrant blooms, and often striking foliage, making many members highly valued in both traditional medicine and ornamental hor-

ticulture [6–9]. As such, the genus holds not only botanical interest but also practical importance in ethnobotany [8–10].

Kaempferia is taxonomically diverse and divided into two main subgenera based on inflorescence position and development [11–13]. In subgenus *Protanthium* Horan., the inflorescence emerges directly from the rhizome before or simultaneously with the leafy shoot or laterally beside it [11–15]. In contrast, subgenus *Kaempferia* produces terminal inflorescences on leafy shoots [13,16,17]. This morphological distinction is important for both field identification and understanding evolutionary adaptations in the genus [18–23]. Despite these clear morphological patterns, species delimitation remains challenging, often due to overlapping characteristics, limited flowering periods, and under collection in the regions.

Myanmar, situated at the confluence of the Indo-Burma and Sino-Himalayan floristic regions [24–27], is one of Mainland Southeast Asia's most biodiverse yet underexplored countries. To date, nine *Kaempferia* species—*K. angustifolia* Roscoe, *K. elegans* Wall., *K. galanga* L., *K. gilbertii* W.Bull, *K. ovalifolia* Roxb., *K. parviflora* Wall. ex Baker, *K. pseudoparviflora* Saensouk & P.Saensouk, *K. roscoeana* Wall., and *K. rotunda* L.—have been recorded from Myanmar [1,12]. However, recent field surveys and herbarium examinations suggest that this number under-represents the true diversity of the genus in the country.

During recent botanical explorations in Myanmar, two additional *Kaempferia* species were discovered. One was identified as *K. simaoensis* Y.Y.Qian, previously known only from China and Thailand but not yet documented in Myanmar [1,28,29]. The second taxon is morphologically similar to *K. simaoensis* but differs distinctly in several floral and vegetative characters and is therefore described in this paper as a new species, *K. kayinensis*.

Notably, *Kaempferia parishii* Hook.f. [30] has been treated as a synonym of *K. ovalifolia* Roxb. [31], as noted in Plants of the World Online [1]. However, our reassessment of the protologue, illustrations, and herbarium specimens reveals clear morphological differences in inflorescence position: *K. parishii* produces lateral inflorescences, whereas *K. ovalifolia* produces terminal inflorescences, indicating that they belong to different subgenera. We therefore reinstate *K. parishii* Hook.f. as an independent species.

This study formally describes *Kaempferia kayinensis* as a new species, reports the first record of *K. simaoensis* in Myanmar, and reassesses the status of *K. parishii* within subgenus *Protanthium*. The plants in this genus exhibit compact growth habits, vibrant floral displays, and seasonal inflorescence emergence directly from the soil, traits that make them suitable as ornamental potted plants, although they are still not widely known. Understanding their taxonomy, diversity, distribution, habitat preferences, and conservation status is essential information for planning the conservation and sustainable use of Myanmar's native flora.

2. Materials and Methods

2.1. Plant Materials and Study Area

Entire flowering plants were collected during botanical fieldwork conducted between 2024 and 2025 in Kayin State, Myanmar (Figure 1), by collaborating local researchers. Specimens of *Kaempferia* were collected in accordance with established botanical collecting standards [32]. The collected material included intact plants bearing flowers, with floral parts preserved in 70% ethanol for detailed morphological examination. Voucher specimens, including the type collection, were pressed, assigned unique collection numbers, and deposited in the RAF herbarium, Myanmar. Ecological data, including habitat characteristics and associated plant species, were recorded for each population at the time of collection.

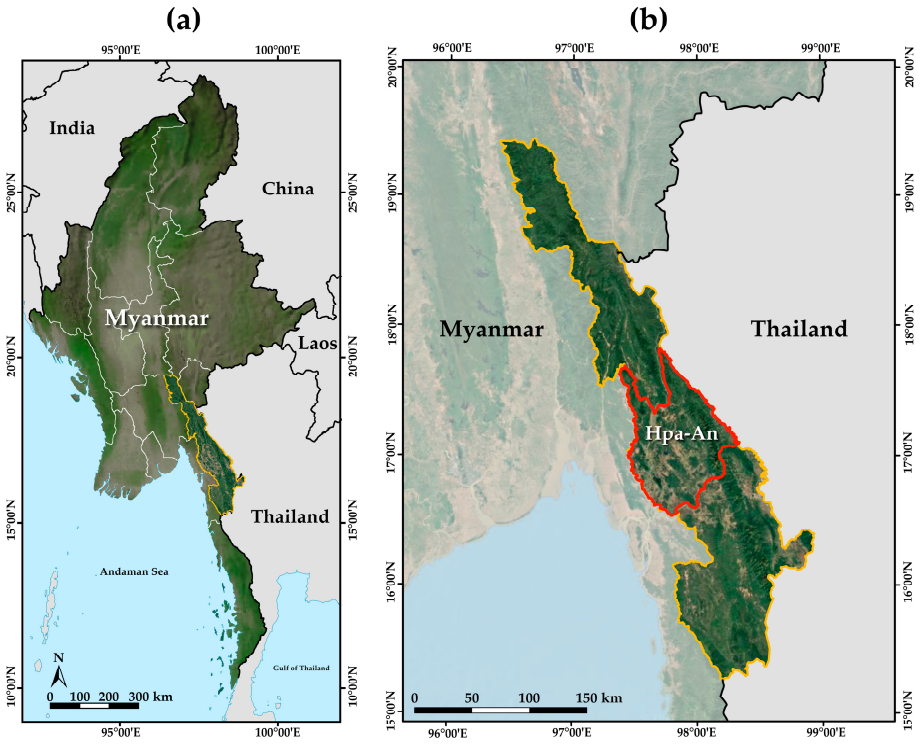

Figure 1. Map of the study area: (**a**) location of Kayin State (outlined in yellow) within Myanmar; (**b**) location of Hpa-An District (outlined in red) within Kayin State. Base map adapted from Esri Topographic Map—Source: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors (accessed on 1 January 2026). Created by Thawatphong Boonma using Pixelmator Pro (Version 3.6.15, Archipelago, 2025; Pixelmator Team, Vilnius, Lithuania).

2.2. Morphological Observations

Morphological characteristics were investigated using both fresh material and preserved specimens. Quantitative measurements of vegetative and reproductive structures were obtained using a standard ruler and a Mitutoyo vernier caliper (Mitutoyo Corporation, Kawasaki, Japan). Fine-scale morphological features, including surface texture and inflorescence structures, were examined under a stereoscopic microscope (Stemi 2000-C; Zeiss, Oberkochen, Germany).

Species identification was based on comparisons with regional floras [2–4,33–36] and relevant taxonomic literature [9,12–17,28–31,37–39]. Morphological terminology was applied following Beentje [40]. Nomenclature followed Plants of the World Online [1] and the International Plant Names Index [41], while herbarium acronyms were standardized according to the Index Herbariorum [42]. Specimens were examined from multiple herbaria through both direct (on-site) study and online consultation. Physical examinations were conducted for accessible collections, whereas specimens from herbaria with limited accessibility were studied using digital images and online databases, including the Chinese virtual herbarium (https://www.cvh.ac.cn, accessed 9 January 2026). Specimens examined on-site are from the following herbaria: A, AAU, B, BK, BKF, BM, C, CAL, E, HN, HNPM, HNU, IBK, IMDY, K, KKU, L, P, QBG, SGN, SING, VMSU, VNM, and VNMN. Specimens examined exclusively through online resources are from the following herbaria: HITBC, NY, RAF, and TNS. Conservation assessments were conducted in accordance with the IUCN Red List Categories and Criteria [43].

All graphical materials were produced using Pixelmator Pro (version 3.6.5, "Archipelago"; Pixelmator Team, Vilnius, Lithuania) on a MacBook Pro (13-inch, M1, 2020; Apple Inc., Cupertino, CA, USA). Scientific illustrations were digitally prepared using an Apple iPad

Air (5th generation) running iPadOS 17.5.1 (21F90). All figure plates were prepared by Thawatphong Boonma.

3. Results

3.1. Taxonomic Treatments

3.1.1. New Species

Kaempferia kayinensis Boonma, Paing, Saensouk & P.Saensouk, **sp. nov.**

Type: MYANMAR. Kayin State, Hpa-An District, Hlaingbwe Township, Hti Lon, c. 150 m above mean sea level, 23 May 2024 (in flower), *Chit Soe Paing 004* (Holotype RAF: Including flowers preserved in spirit as part of a single specimen).

Diagnosis: *Kaempferia kayinensis* is similar to *K. simaoensis* in producing lateral inflorescences, but differs in having abaxially floccose lamina (not villous), stramineous and puberulous bracts with cream veins (not white to vinaceous and glabrous), stramineous calyx with cream veins and unlobed apex (not trilobed), dorsal corolla lobe with a caudate apex (not acuminate), and a smaller, purple labellum with a single saffron median stripe (not with two conspicuous yellow longitudinal stripes) (Figures 2 and 3; Table A1).

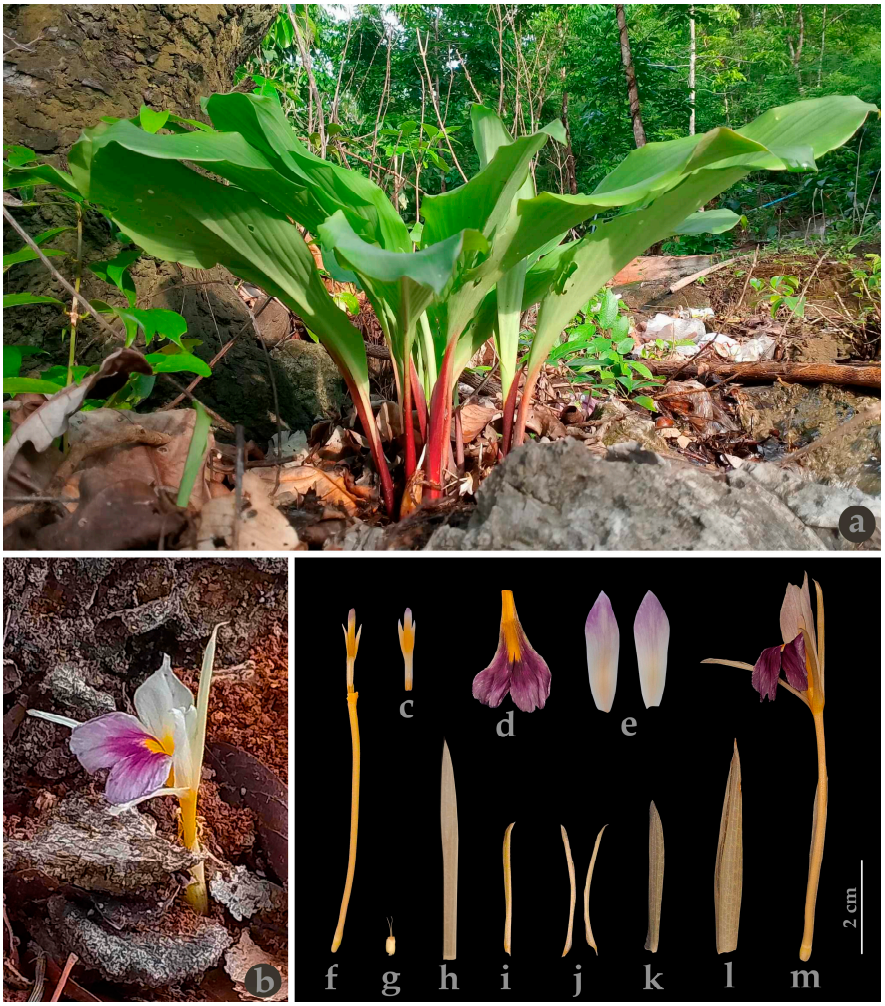

Figure 2. *Kaempferia kayinensis* Boonma, Paing, Saensouk & P.Saensouk: (**a**) Habits in natural habitat. (**b**) Semi-side view of flower. (**c**) Back side of anther. (**d**) Labellum. (**e**) Lateral staminodes. (**f**) Floral tube with anther and ovary. (**g**) Ovary with epigynous glands. (**h**) Calyx. (**i**) Dorsal corolla lobe. (**j**) Lateral corolla lobes. (**k**) Bracteole. (**l**) Bract. (**m**) Side view of flower.

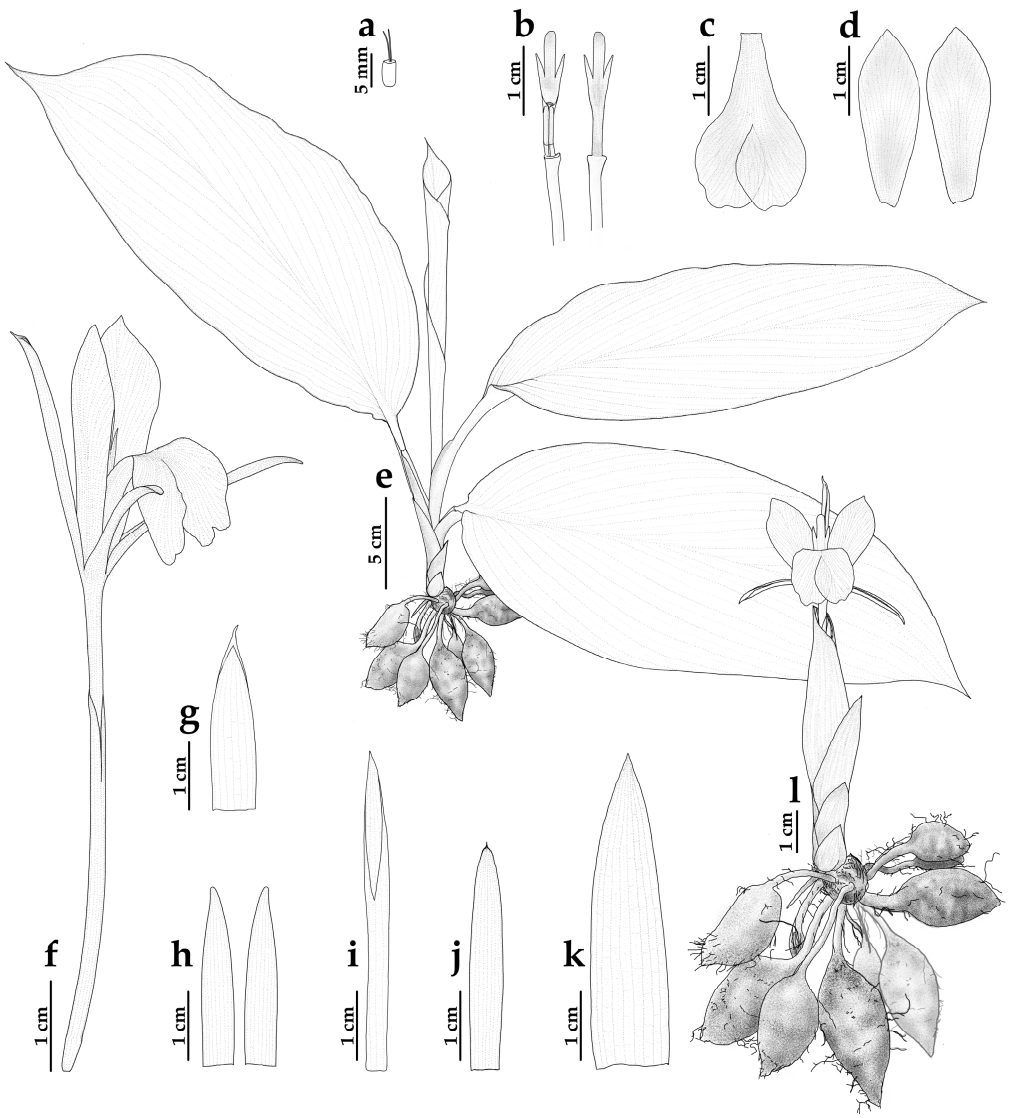

Figure 3. *Kaempferia kayinensis* Boonma, Paing, Saensouk & P.Saensouk: (**a**) Ovary with epigynous glands. (**b**) Front and back view of anther. (**c**) Labellum. (**d**) Lateral staminodes. (**e**) Habit. (**f**) Side view of flower. (**g**) Dorsal corolla lobe. (**h**) Lateral corolla lobes. (**i**) Calyx. (**j**) Bracteole. (**k**) Bract. (**l**) Inflorescence with flower, rhizome, and tuberous roots. Illustration drawn by Thawatphong Boonma.

Description: Perennial herb, rhizome short ovoid to subglobose, pale yellow inside and fragrant. Root fibrous and with tuberous; tuberous prolate to fusiform, 2–4 cm long and 1.2–2 cm in diameter, positioned near the rhizome, 1–3 cm away. Leafy shoot 20–40 cm tall. Leafless sheaths 2–3, maroon, with white underground part, apex mucronate, margin entire, puberulous. Leaf-sheaths alternate, green with maroon tinged, puberulous. Petiole green with maroon tinged, puberulous. Ligule bilobed, membranous, ciliate. Lamina 3–4, ovate, apex acuminate, base attenuate, margin undulate, adaxially surface plain green, glabrescent, punctate, prominently vein; midrib green; abaxially pale green, sometimes with reddish tinge at the margin, floccose, 15–22 × 8–12 cm. Inflorescence directly from rhizome enclosed by bracts appears before the new leaves; peduncle cylindrical, ivory, 1.8–2.0 cm long. Bracts lanceolate-triangular, 4–5 × 1–1.3 cm, stramineous with cream veins, apex attenuate, margin entire, puberulous. Bracteole 3.0–3.5 × 0.7–0.8 cm, oblanceolate–ensiform, apex obtuse, margin entire, glabrescent, except a few hairs at tip. Flowers 8.4–8.6 cm long. Calyx tubular, semi-translucent stramineous with cream veins, 4.2–4.7 cm long from apex, apex unlobed with incision up to 2 cm, glabrescent. Floral tube tubular, saffron with

pale stramineous toward the base, 5–5.5 cm long, glabrous; dorsal corolla lobe one and hooded, 2.8–2.9 cm long, 0.5–0.6 cm wide, cream to stramineous, lanceolate–ensiform, apex caudate (caudate c. 3 mm long), margin entire, glabrous; lateral corolla lobes 2, cream to stramineous, lanceolate–ensiform, hooded, 2.8–2.9 cm long, 0.5–0.6 cm wide, apex obtuse, margin entire, glabrous. Lateral staminodes 2, upright to slightly arcuate, ivory tinged with stramineous at the lower part and tinged with mauve toward the distal part, oblanceolate, apex acute, glabrous, 2.2–2.7 × 0.8–1.2 cm. Labellum obovate, bilobed, 2.5–2.6 × 1.5–1.6 cm, deeply divided 1.0–1.1 cm to sinus, each lobe elliptic, partly overlapping, purple, bearing a saffron stripe (c. 1.5 cm long, 2–3 mm wide) running longitudinally from the sinus to the base, the basal margins slightly ivory, apex undulate to slightly crisped, or emarginate, glabrous. Stamen c. 22 mm long; filament c. 3 mm long, saffron; anther 17–18 mm long (including crest), ivory to cream with saffron crest; anther thecae ivory to cream, 6–6.5 mm long; anther crest trilobed, the lateral lobes acuminated and the central lobe oblong with rounded to truncate apex and longer than the lateral lobes, saffron, apically cream or with mauve tinged, c. 10 mm long (lateral lobes c. 7 mm long), 4–7 mm wide, glabrous. Stigma white, c. 1 × 1 mm, ciliate. Style very slender, 6–6.5 cm long. Epigynous glands acicular 2, 4–4.5 mm long, pale stramineous. Ovary terete, c. 3 mm long, and 2–2.5 mm in diameter, 3 carpels, pale stramineous, glabrous. Ovule axile placentation. Fruit and seed not seen.

Additional specimen examined (paratype): MYANMAR. Kayin State, Hpa-An District, 150 m elevation, 8 August 2024, *Chit Soe Paing 005* (RAF).

Etymology: The specific epithet "*kayinensis*" refers to Kayin State in Myanmar, where the species was discovered.

Distribution and habitat: *Kaempferia kayinensis* is currently known only from its type locality in Hpa-An District, Kayin State, Myanmar. It grows in rock crevices containing organic-rich soil, under partial shade or in light-exposed habitats.

This species is currently documented only from its type locality, and additional field surveys are required to confirm whether it occurs in other areas. Because information on its distribution, population size, and possible threats remains insufficient, the species is provisionally assessed as Data Deficient (DD) following the Guidelines for Using the IUCN Red List Categories and Criteria, version 16 [43].

3.1.2. New Record for Myanmar

Kaempferia simaoensis Y.Y.Qian, *Acta Bot. Austro Sin.* 10: 65–67 (1995).

Type: CHINA. Yunnan, Simao, c. 900 m a.s.l., 10 May 1990, *Y.Y.Qian 2219* (holotype: HITBC, image!).

Specimens examined from Myanmar: Kayin State, Myawaddy Township, Yetagun Village, Ah Ma Ka Yetagun Taung, 5 May 2025, *Min Khant Naing 2501* (RAF).

Description based on specimens collected from Myanmar: Perennial herb, rhizome subglobose, 1.5–2.0 cm in diameter. Root fibrous and with tuberous; tuberous fusiform, 3–4 cm long and 1.2–1.5 cm in diameter. Leafy shoot 30–55 cm tall. Leafless sheaths 1–2, green to vinaceous, with white underground part, apex rounded, sparsely hair. Leaf-sheaths alternate, green or vinaceous tinged. Petiole green with vinaceous tinged, sparsely hair. Ligule bilobed, membranous, broadly triangular, 3–4 mm long, pale green, sparsely hair. Lamina 4–7, ovate to elliptic, rarely lanceolate, apex acute, base cuneate, margin entire, adaxially surface green to dull green, midrib green to vinaceous tinged, prominently plicate, glabrous; abaxially pale green, rarely with vinaceous tinge, villous, 7–32 × 4–12 cm. Inflorescence directly from rhizome enclosed by bracts appears before the new leaves; peduncle cylindrical, whitish, 0.5–1.6 cm long. Bracts broadly ovate to lanceolate-ovate, 4.0–5.5 × 3.2–3.8 cm, white to vinaceous, apex acute, margin entire, glabrous. Bracteole 1.5–3.0 × 0.7–1.3 cm, lanceolate, apex bilobed, each lobe acute, margin entire, glabrous.

Flowers 10.5–11.2 cm long; floral plane perpendicular. Calyx tubular, pale purple above the middle, white below the middle, 4–6 cm long, apex tri-lobed with an incision up to 1.5 cm long from apex, membranous, sparsely villous. Floral tube tubular, white, 4–7 cm long; dorsal corolla lobe one and hooded, 3.5–4.5 cm long, 0.6–0.7 cm wide, white, lanceolate, apex acuminate, margin entire, glabrous; lateral corolla lobes 2, white, lanceolate, hooded, 3–4 cm long, 0.3–0.5 cm wide, apex acuminate, margin entire, glabrous. Lateral staminodes 2, pale purple above the middle, white below the middle, obovate, apex acuminate, 3.0–3.5 × 0.9–1.2 cm, erect, overlapping above the middle. Labellum obovate, bilobed, 3.0–4.0 × 2.0–3.0 cm, deeply divided 1.2–1.5 cm to sinus, each lobe obovate, partly overlapping, purple with median part dark purple, apices acuminate, entire, rarely slightly 2-lobed, deflexed, midrib with two conspicuous yellow stripes running longitudinally from the sinus to the base, the basal and margins whitish. Stamen 15–22 mm long; filament 3.0–4.0 mm long, ivory; anther 15–20 mm long (including crest), ivory to cream with white or pale purple crest; anther thecae ivory to cream, 7–10 mm long; anther crest lanceolate to broadly ovate, white or with pale purple veins or pale purple, 8–10 mm long, entire, apex rounded, obtuse or bilobed, lobes lanceolate, 2.5–5.0 mm long, or unequal lobes with apices acute. Stigma turbinate, villous. Style very slender, 5–7.5 cm long. Epigynous glands acicular 2, 5–7 mm long, yellowish. Ovary terete, broader upward, 4–5 mm long, and 2–3 mm in diameter, 3 carpels, cream to light reddish, glabrous, rarely sparsely villous. Ovule axile placentation. Fruit and seed not seen (Figure 4).

Notes: The Myanmar specimens of *Kaempferia simaoensis* correspond well with the original description [28] and with material reported from Thailand [29,33] in all key diagnostic characters, particularly the hysteranthous habit, rhizome with terminal tubers, general floral morphology, labellum color pattern with yellow markings, lateral staminodes, anther crest, epigynous glands, and villous stigma. Differences are confined to vegetative size, indumentum, and certain inflorescence characters (Table A2). Plants from Myanmar are generally taller and bear larger leaves, with comparatively larger and glabrous bracts and bracteoles, and a slightly longer peduncle than reported in the protologue. Comparable trends are also evident in Thai material, indicating a geographically structured but continuous range of variation rather than discrete morphological separation. Minor variation in the shape and degree of lobing of the anther crest (from entire to bilobed or weakly trilobed) further falls within this continuum. As these differences are not associated with any divergence in reproductive diagnostic characters, they are best interpreted as intraspecific variation, possibly influenced by environmental or geographic factors. The Myanmar collections therefore represent a reliable new country record of *K. simaoensis*.

Additional specimens examined: Thailand; Northern, Tak Province, Phop Phra, Thararak waterfall, 16 May 2007, *R. Pooma 6792* (BKF); Tak Province, Umphang, Doi Hua Mot, 28 May 2008, *R. Pooma 6964* (BKF); Tak province, Mae Sot, 16 April 2015, *N. Nopporncharoenkul NNSB 322* (BKF); Tak Province, Phop Phra, 27 May 2019, *T. Boonma 527* (VMSU). Thailand; Southwestern, Kanchanaburi Province, Thong Pha Phum, 13 April 2014, N. Nopporncharoenkul NNSB 161 (BKF).

The specimen *Y.Y.Qian 2259* (HITBC) is labelled as "isotype". However, since it does not correspond to the holotype number *Y.Y. Qian 2219* (HITBC), it is treated in this paper as additional material.



Figure 4. *Kaempferia simaoensis* Y.Y.Qian.: (**a**) Flowers in natural habitat. (**b**) Habits. (**c**) Side view of floral tube with calyx and ovary. (**d**) Anther crest with rounded apex. (**e**) Anther crest with unequal lobes and apices acute. (**f**) Midrib of labellum with two yellow stripes running longitudinally. (**g**) Semi top view of inflorescence with flowers.

3.1.3. Taxonomic Clarification of *Kaempferia ovalifolia* Roxb. and the Reinstatement of *Kaempferia parishii* Hook.f.

Historical Background and Morphological Evidence

The position of the inflorescence has long been recognized as a stable and taxonomically informative character in *Kaempferia*. Species with a terminal inflorescence emerging from between the leaf sheaths are currently placed in *Kaempferia* subgen. *Kaempferia*, whereas species with a lateral, basal inflorescence that appears before the leaves (hysteranthous) belong to subgen. *Protanthium* [11–15].

In 1819, the protologue of *Kaempferia ovalifolia* Roxb. [31], the species was clearly described and illustrated as having a terminal inflorescence arising centrally among the leaves. The accompanying illustration shows two fully developed leaves, a character consistent with species of subgen. *Kaempferia*. This concept of *K. ovalifolia* is therefore unambiguous and well defined (Figure 5a).



(a) *Kaempferia ovalifolia* Roxb. **(b)** *Kaempferia ovalifolia* sensu Roscoe **(c)** *Kaempferia parishii* Hook.f.

Figure 5. (**a**) *Kaempferia ovalifolia* Roxb. (Roxburgh image 2155), illustration by an unrecorded artist commissioned by William Roxburgh © Board of Trustees, Royal Botanic Gardens, Kew; (**b**) *K. ovalifolia* sensu Roscoe, illustration reproduced from Roscoe [38], Monandrian Plants of the Order Scitamineae; (**c**) *K. parishii* Hook.f., image courtesy of the Biodiversity Heritage Library, contributed by the Missouri Botanical Garden, Peter H. Raven Library.

Subsequently, Roscoe [39] discussed plants sent to the Liverpool Botanic Garden on three occasions from the East Indies under the name *K. ovalifolia*. In his observations, Roscoe explicitly noted that the inflorescence was lateral and appeared before the leaves. This hysteranthous flowering pattern is incompatible with the original concept of *K. ovalifolia* Roxb. and instead corresponds to species of subgen. *Protanthium*. Moreover, Roscoe's illustration depicts a habit clearly distinct from Roxburgh's plant and consistent with a basal-flowering species (Figure 5b). Thus, the name *Kaempferia ovalifolia* sensu Roscoe represents a taxon different from *K. ovalifolia* Roxb., despite Roscoe's own hesitation and discussion regarding the differences observed between his material and Roxburgh's original description [31].

Reinstatement of *Kaempferia parishii* Hook.f.

In 1869, Hooker described *Kaempferia parishii* with specimens from Moalmayne (presently Mawlamyaing), Myanmar [30], based on material exhibiting a lateral inflorescence (hysteranthous) and a trifid anther crest (Figure 5c), characters that closely match those reported and illustrated of *K. ovalifolia* sensu Roscoe [38], but differ in the short, oblong, appressed, reticulate lower sheaths of the flowering scape, and in two lower inner perianth-segments not being appendaged in the sinus [30]. Although *K. parishii* was later reduced to synonymy under *K. ovalifolia* Roxb. [1], this treatment overlooked the fundamental difference in inflorescence position and flowering phenology between Roxburgh's species and Roscoe's plant [30,31,38]. Based on a re-examination of the original descriptions, illustrations, and diagnostic morphological characters, it is evident that *K. parishii* Hook.f. [30] did not match with *K. ovalifolia* Roxb. [31]. To resolve this long-standing taxonomic confusion, *K. parishii* Hook.f. is reinstated in this paper as a distinct and independent species.

Kaempferia diversifolia Link ex A.Dietr. [37] has previously been treated as a synonym of *K. ovalifolia* Roxb. [31], and this taxonomic position is maintained in this paper. The characters provided in the original description of *K. diversifolia*, including leaf morphology and floral structure, fall within the morphological variation of *K. ovalifolia* Roxb. as originally described. There is no evidence to suggest that *K. diversifolia* corresponds to *K. ovalifolia* sensu Roscoe [38] or to *K. parishii* Hook.f. [30].

Accordingly, the following taxonomic conclusions are accepted:

***Kaempferia parishii* Hook.f.**, *Curtis's Botanical Magazine* 95: Table 5763 [30].—**stat. rev.**
Lectotype (designated here): Illustration in *Curtis's Botanical Magazine* 95: Table 5763 [30].
Note: Species with lateral, hysteranthous inflorescence; subgen. *Protanthium*.

***Kaempferia ovalifolia* Roxb.**, *Plants of the Coast of Coromandel* 3: 75–76, pl. 278 [31].
Lectotype (designated in this paper): Roxburgh Icones, no. 2155 (K).
Synonym: *Kaempferia diversifolia* Link ex A.Dietr., *Sp. Pl.* ed. 6, 1(1): 57–58 [1].
Type: No original specimens have been located.
Note: Species with terminal inflorescence; subgen. *Kaempferia*.

Kaempferia ovalifolia sensu Roscoe [38] is treated in this paper exclusively as a misapplied name (auct. non Roxb.) and is not placed in synonymy with any accepted species due to insufficient verifiable material. To clarify the long-standing taxonomic confusion surrounding *Kaempferia ovalifolia* Roxb. and its misapplication by later authors, key diagnostic morphological characters were compared among *K. ovalifolia* Roxb., the misapplied taxonomic concept referred to as *K. ovalifolia* sensu Roscoe, and *K. parishii* Hook.f. Particular emphasis was placed on inflorescence position, flowering phenology, vegetative habits at anthesis, and floral morphology, as these characters are stable and taxonomically informative within *Kaempferia*. The comparative analysis is summarized in Table A3.

3.1.4. Key to Species of *Kaempferia* subgen. *Protanthium* in Myanmar

The following key (Table 1) is provided to facilitate the identification of species of *Kaempferia* subgen. *Protanthium* currently known from Myanmar. Members of this subgenus are characterized by a lateral, basal inflorescence emerging directly from the rhizome prior to leaf development (hysteranthous), a feature that readily distinguishes them from species of subgen. *Kaempferia*, in which the inflorescence is terminal and produced among the leaf sheaths of the leafy shoot (synanthous).

Table 1. Key to species of *Kaempferia* subgen. *Protanthium* in Myanmar.

Characters	Species
1a. Lamina usually variegated with white, silver or light green patterns	*K. rotunda*
1b. Lamina uniformly green	2
2a. Labellum bright violet-purple throughout, without yellow/saffron stripe	*K. parishii*
2b. Labellum purple with pale basal area with yellow/saffron stripe	3
3a. Filament ivory; labellum with two conspicuous yellow longitudinal stripes from sinus to base; floral tube white	*K. simaoensis*
3b. Filament saffron; labellum with a single saffron median stripe from sinus to base; floral tube saffron with pale stramineous base	*K. kayinensis*

4. Discussion

The present study provides new insights into the diversity, taxonomy, and distribution of *Kaempferia* in Myanmar through the description of new species, *K. kayinensis* from Kayin State, the documentation of *K. simaoensis* as a new country record, and the taxonomic reassessment of *K. parishii*. These findings demonstrate that the diversity of *Kaempferia* in Myanmar remains incompletely known and that additional floristic and taxonomic studies are needed to fully document the genus in the region.

According to the most recent checklist of vascular plants of Myanmar [44], these species occur across several floristic regions of Myanmar, including Kachin, Sagaing, Mandalay, Shan, Bago, Ayeyarwady, Yangon, Mon, and Tanintharyi. However, the available records remain unevenly distributed geographically, with many collections originating from southern and central regions, whereas comparatively few botanical surveys have been conducted in southeastern areas such as Kayin State. While *Kaempferia pseudoparviflora* Saensouk & P.Saensouk was previously reported from Myanmar based on collections from Kayin State and Mon State [12], but this species was not included in the recent checklist of vascular plants of Myanmar [44].

In the present study, the documentation of *K. simaoensis* as a new country record, the description of *K. kayinensis* as a new species, and the reinstatement of *K. parishii* further increase the number of known *Kaempferia* species in Myanmar to twelve. Within this diversity, four species (*K. rotunda*, *K. parishii*, *K. simaoensis*, and *K. kayinensis*) belong to *Kaempferia* subgen. *Protanthium*, characterized by an inflorescence arising directly from the rhizome before leaf emergence (hysteranthous). The increasing number of recorded taxa, particularly within this subgenus, suggests that the diversity of *Kaempferia* in Myanmar remains incompletely documented. Given the wide range of habitats and the limited intensity of botanical exploration in many regions of the country, additional species are likely to be discovered through further floristic and taxonomic studies.

Morphological evidence clearly supports the recognition of *K. kayinensis* as a distinct species within *Kaempferia* subgen. *Protanthium*, can be readily distinguished from *K. simaoensis* by several vegetative and floral characters. These include the glabrescent and punctate adaxial leaf surface with a floccose abaxial indumentum, the stramineous bracts with attenuate apices, oblanceolate–ensiform bracteoles with an obtuse apex, and a saffron-colored filament. In addition, the species possesses a distinctive trilobed anther crest with a central lobe longer than the lateral lobes, whereas *K. simaoensis* generally exhibits an obtuse or bilobed anther crest. The presence of a single saffron median stripe on the labellum further differentiates *K. kayinensis* from *K. simaoensis*, which bears two conspicuous yellow longitudinal stripes.

The Myanmar specimens of *K. simaoensis* correspond closely with the original description and previously documented material from China and Thailand [4,28,29] in all key diagnostic characters, including floral morphology, labellum pattern, stigma structure, and anther crest morphology. Minor differences observed in vegetative size and peduncle length likely represent environmentally influenced variation rather than taxonomic differences. Such variation is common within *Kaempferia*, where vegetative traits can be strongly affected by ecological factors such as light availability, soil conditions, and seasonal moisture. The Myanmar material therefore represents a reliable new country record of *K. simaoensis*.

The occurrence of *K. simaoensis* in Myanmar extends the known distribution of the species westward from its previously documented range in southwestern China [4,28] and northwestern Thailand [29]. This distribution pattern is biogeographically plausible because southeastern Myanmar lies within a floristic corridor connecting the Indo-Burma and Sino-Himalayan regions. Many plant taxa, particularly within Zingiberaceae, show

similar transboundary distributions across these areas, reflecting shared geological history and comparable ecological conditions [2,4,24–27].

The discovery of *K. kayinensis* in Kayin State further highlights the importance of southeastern Myanmar as a region of significant botanical interest. The species was found growing in rock crevices containing organic-rich soil under partially shaded conditions, suggesting an ecological preference for rocky or limestone-associated microhabitats. Karst landscapes are well known for supporting specialized plant communities and frequently harbor narrowly distributed endemic species due to their heterogeneous microhabitats and distinctive edaphic conditions. Comparable patterns of local endemism have been reported for several Zingiberaceae species occurring in limestone habitats in Thailand [9,45,46], suggesting that similar diversification processes may occur in the karst landscapes of Myanmar.

The reassessment confirms that *Kaempferia parishii* is best interpreted in light of inflorescence position and flowering phenology, which remain key diagnostic characters within the genus. Evidence from the protologue and illustrations of *K. ovalifolia* Roxb. [31] indicates a terminal inflorescence produced among the leaves, supporting its placement within subgen. *Kaempferia* [11].

In contrast, the plant described and illustrated by Roscoe [38] under the name *K. ovalifolia* exhibits a lateral inflorescence that appears before leaf emergence, a condition characteristic of subgen. *Protanthium*. This clearly differs from the protologue of *K. ovalifolia* Roxb. [31], which possesses a terminal inflorescence emerging centrally among the leaves and is therefore referable to subgen. *Kaempferia*. However, the morphology depicted by Roscoe [38] does not correspond with the diagnostic characters of *K. parishii* Hook.f. [30]. *Kaempferia ovalifolia* sensu Roscoe therefore represents a misapplication of the name. The reinstatement of *K. parishii* as a distinct species thus helps clarify the taxonomic confusion surrounding these names and aligns the classification with the morphological framework currently used for the genus.

Furthermore, *Kaempferia ovalifolia* sensu Roscoe (auct. non Roxb.) [38] represents a misapplied name referable to a hysteranthous, laterally flowering taxon of subgen. *Protanthium* and is not conspecific with *K. ovalifolia* Roxb. [31]. The material on which Roscoe's concept was based was reported only from the imprecise locality "East Indies" and lacks verifiable provenance. In the absence of authenticated specimens or unequivocal distributional evidence, *K. ovalifolia* sensu Roscoe (auct. non Roxb.) is therefore excluded from the flora of Myanmar.

Further botanical exploration in Kayin State and other under-surveyed regions of Myanmar will likely reveal additional populations of *K. kayinensis* or possibly additional undescribed taxa of *Kaempferia*. Future research integrating extensive field surveys, detailed herbarium studies, and molecular phylogenetic analyses will be essential for clarifying species boundaries, understanding evolutionary relationships, and documenting patterns of diversification within the genus across mainland Southeast Asia. Such studies will contribute significantly to improving taxonomic knowledge and supporting conservation planning for Myanmar's native plant diversity.

5. Conclusions

This study contributes to improving the taxonomic and floristic knowledge of *Kaempferia* in Myanmar through the description of *K. kayinensis* as a new species, the documentation of *K. simaoensis* as a new country record, and the taxonomic reassessment of *K. parishii*. These findings increase the number of known species of *Kaempferia* in Myanmar to twelve and highlight the presence of four species of *Kaempferia* subgen. *Protanthium* in the country.

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Abbreviations

The following abbreviations are used in this manuscript:

A	Harvard University, Cambridge, Massachusetts, U.S.A.
AAU	Aarhus University, Denmark
B	Botanic Garden and Botanical Museum Berlin-Dahlem, Germany
BK	Bangkok Herbarium, Department of Agriculture, Thailand
BKF	Department of National Parks, Wildlife and Plant Conservation, Thailand
BM	The Natural History Museum, London, England, U.K.
C	University of Copenhagen, Copenhagen, Denmark
CAL	Botanical Survey of India, Howrah, West Bengal, India
E	Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom
HITBC	Xishuangbanna Tropical Botanical Garden, Academia Sinica, Yunnan, China
HN	Vietnam Academy of Science and Technology (VAST), Hanoi, Vietnam
HNPM	National Institute of Medicinal Materials, Vietnam
HNU	VNU University of Science, Hanoi, Vietnam
IBK	Guangxi Institute of Botany, China
IMDY	Chinese Academy of Medical Sciences, China
K	Royal Botanic Gardens, United Kingdom
KKU	Khon Khan University Herbarium, Thailand
L	Naturalis Biodiversity Center, Leiden, Netherlands
NY	The New York Botanical Garden, New York, U.S.A.
P	Muséum National d'Histoire Naturelle, Paris, France
QBG	Queen Sirikit Botanic Garden, The Botanical Garden Organization, Thailand
RAF	Forest Research Institute, Nay Pyi Taw, Myanmar
SGN	Southern Institute of Ecology, Ho Chi Minh City, Vietnam
SING	Singapore Botanic Gardens, National Parks Board, Singapore
TNS	National Museum of Nature and Science, Tokyo, Japan
VMSU	Vascular Plant Herbarium, Mahasarakham University, Thailand
VNM	Institute of Life Science, Ho Chi Minh City, Vietnam
VNMN	Vietnam National Museum of Nature, Hanoi, Vietnam

Appendix A

Table A1. Morphological comparison between *Kaempferia simaoensis* [4,28,29,33] and *K. kayinensis*.

Characters	*Kaempferia simaoensis* [4,28,29,33]	*Kaempferia kayinensis* (Present Study)
Lamina	2–7 in number Ovate to elliptic, rarely lanceolate Margin entire Adaxially surface glabrous Midrib green or vinaceous tinged Abaxially villous 7.0–40.0 × 2.5–17.0 cm	3–4 in number Ovate Margin undulate Adaxially surface glabrescent, punctate Midrib green Abaxially floccose 15.0–22.0 × 8.0–12.0 cm
Bracts	1.1–5.5 × 0.4–4.0 cm White to vinaceous, or with purple dots Apex acute, glabrous	4.0–5.0 × 1.0–1.3 cm Stramineous with cream veins Apex attenuate, puberulous
Bracteole	0.8–3.0 × 0.3–1.3 cm Lanceolate Apex bilobed, each lobe acute Glabrous	3.0–3.5 × 0.7–0.8 cm Oblanceolate–ensiform Apex obtuse Glabrescent, except a few hairs at tip
Flowers	10.5–11.2 cm long	8.4–8.6 cm long
Calyx	Pale purple with white below the middle Apex tri-lobed	Stramineous with cream veins Apex unlobed
Floral tube	4.0–7.0 cm long White	5.0–5.5 cm long Saffron with pale stramineous base
Dorsal corolla lobe	3.5–4.5 cm long White, apex acuminate	2.8–2.9 cm long Cream to stramineous, apex caudate
Lateral corolla lobes	3.0–4.0 cm long 0.3–0.5 cm wide White, apex acuminate	2.8–2.9 cm long 0.5–0.6 cm wide Cream to stramineous, apex obtuse
Lateral staminodes	3.0–3.5 × 0.9–1.2 cm White below the middle, with pale purple toward the distal part	2.2–2.7 × 0.8–1.2 cm Ivory tinged with stramineous at the lower part and tinged with mauve toward the distal part
Labellum	3.0–4.0 cm long 2.0–3.0 cm wide Bilobed, divided 1.2–1.5 cm to sinus Each lobe obovate, apex acuminate, entire, rarely slightly 2-lobed Purple with median part dark purple, midrib with **two conspicuous yellow stripes** running longitudinally from the sinus to the base, the basal and margins whitish	2.5–2.6 cm long 1.5–1.6 cm wide Bilobed, divided 1.0–1.1 cm to sinus Each lobe elliptic, apex undulate to slightly crisped, or emarginate Purple, midrib with **a saffron stripe** (c. 1.5 cm long, 2–3 mm wide) running longitudinally from the sinus to the base, the basal margins slightly ivory
Filament	Ivory	Saffron
Anther	Ivory to cream with white or pale purple crest	Ivory to cream with saffron crest
Anther thecae	7–10 mm long	6–6.5 mm long
Anther crest	Obtuse to bilobed, or lanceolate, rounded, unequal lobes with acute apex, or trilobed White with pale purple veins, or pale purple	Trilobed, lateral lobes acuminated, and the central lobe oblong with rounded to truncate apex and longer than the lateral lobes Saffron, apically cream or with mauve tinged
Epigynous glands	5.0–7.0 mm long	4.0–4.5 mm long
Ovary	4.0–5.0 mm long Cream to light reddish	c. 3.0 mm long Pale stramineous

Table A2. Morphological differences of *Kaempferia simaoensis* among protologue [28], Flora of China [4], Thailand [33], New record for Thailand [29], and Myanmar specimens of the present study.

Characters	Protologue [28]	Flora of China [4]	Flora of Thailand [33]	New Record for Thailand [29]	Present Study (Myanmar)
Plant height (cm)	10–40	10–40	12–50	25–50	30–55
Leaf blade size (cm)	7–27 × 2.5–9.5	7–27 × 2.5–9.5	13–40 × (2.5–) 6–17	16–35 × 6–15	7–32 × 4–12
Peduncle length (cm)	1–2	1–2	Subsessile to 4	0.5–1.5	0.5–1.6
Bract size (cm)	1.1–1.6 × 0.4–0.6	1–1.6 (length only given)	4.5–5.5 × 3.4–4	4.5–5.5 × 3.4–4	4.0–5.5 × 3.2–3.8
Bract coloration	White with purple dots	White with purple dots	Cream to light purplish red	White to light purplish red	White to vinaceous
Bracteole size (cm)	0.9–1.0 × 0.3–0.5	0.9–1.0 × 0.3–0.5	0.8–2.5 × 0.7–1.2	1.6–2.5 × 0.7–1.2	1.5–3.0 × 0.7–1.3
Bracteole indumentum	Not stated	Not stated	Glabrous	Glabrous	Glabrous
Anther crest shape	Lanceolate	Lanceolate	Narrowly ovate to broadly ovate, rarely suborbicular	Narrowly ovate	Lanceolate to broadly ovate
Anther crest size (mm long)	8–10	8–10	7–12	7–12	8–10
Anther crest apex form	Entire or bilobed	Entire or 2-cleft	Obtuse to trilobed-undulate	Obtuse to shallowly trilobed	Entire, obtuse, or bilobed
Anther crest lobing detail	Lobes equal or unequal, 2.5–5 mm long	Not detailed	Middle lobe longer than lateral lobes (when trilobed)	Middle lobe more elongated than outer lobes	Lobes lanceolate, equal or unequal
Anther crest coloration	White with pale purple veins or pale purple	White with purple veins	Not stated	Not stated	White or with pale purple veins or pale purple

Table A3. Comparative morphology and taxonomic interpretation of *Kaempferia ovalifolia* Roxb., *K. ovalifolia* sensu Roscoe, and *K. parishii* Hook.f.

Characters	*Kaempferia ovalifolia* Roxb. [30]	*K. ovalifolia* sensu Roscoe [37]	*Kaempferia parishii* Hook.f. [29]
Subgenus placement	Subgen. *Kaempferia*	Subgen. *Protanthium*	Subgen. *Protanthium*
Inflorescence position	Terminal	Lateral	Lateral
Flowering time	Synanthous	Hysteranthous	Hysteranthous
Habit	Leafy shoot present at anthesis	Leafless at anthesis	Leafless at anthesis
Number of leaves at anthesis	Two fully developed leaves	Absent	Absent
Anther crest	Not distinctly trifid	Trifid	Trifid
Taxonomic interpretation	Correct application of the name	Misapplied name (auct. non Roxb.)	Distinct species, conspecific with *K. ovalifolia* sensu Roscoe
Current status	Accepted species	Misapplied name	Reinstated as an independent species

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