

THE GENUS *CAULOKAEMPFERIA* K. LARSEN (*ZINGIBERACEAE*) IN LAO PDR PART 1: TWO NEW SPECIES FROM CENTRAL LAO PDR

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Abstract

Two new taxa, *Caulokaempferia phokhamii* Picheans. & Douangde. and *C. wongsuwaniae* Picheans. & Douangde., from central Lao PDR are described. With *C. bracteata* K. Larsen & S.S. Larsen and *C. bolavenensis* Picheans. & Koonterm, a total of four species are currently recognized for Lao PDR. Both new species possess yellow flowers and characteristic labellum with distal median lobe. The hairy pseudostem with reddish-green stripes, hairy ligule, lanceolate leaf blade with reddish brown margin, and the hairy peduncle and bract are characteristic of *C. phokhamii*. The overall tiny habit, glandular lower leaf surface, and 1(–2) bract(s) subtended (1)–2–3 flowers are unique for *C. wongsuwaniae*. Full descriptions, together with line-drawings with water-color and photographic illustrations, of the new species are given.

Key words: *Caulokaempferia*, *Caulokaempferia phokhamii*, *Caulokaempferia wongsuwaniae*, Central Lao PDR, *Zingiberaceae*.

Introduction

The genus *Caulokaempferia* K. Larsen (*Zingiberaceae*) comprises more than 30 species distributed from northeast India (Sikkim, Meghalaya, Manipur and Nagaland), Bhutan, south China, northern Vietnam, Lao PDR and Thailand (Chaiyoot, 2007). Two species were previously enumerated for Lao PDR, i.e. *C. bracteata* K. Larsen & S.S. Larsen (Larsen, 2003) and *C. bolavenensis* Picheans. & Koonterm (Picheansoonthon *et al.*, 2008). These two taxa are all morphologically related to the Thai species distributed on the opposite site of the Mekhong River, particularly by the presence of the distal median lobe of the labellum (Chaiyoot *et al.*, 2008).

In this report, two new species of *Caulokaempferia* K. Larsen are described, with full description, and illustrated. Key to all species accounted for Lao PDR is also included.

Taxonomic treatment

1. *Caulokaempferia phokhamii* Picheans. & Douangde., **sp. nov.** (Figs. 1–2)

This new species is similar to *Caulokaempferia jirawongsei*, but differs in the following characters: (1) hairy pseudostem with reddish green stripes, (2) shorter and hairy ligule (3.2–5.4 mm vs. 0.6–1 cm), (3) lanceolate leaf blade with reddish brown margin, (4) hairy peduncle, and (5) hairy bract.

Type: LAO PDR. Vientiane Province, Hin Herb District, Phou Meut-Phou Kiykon Forest Conservation, Ban Hoiuy Dokmai (Hoiuy Dokmai Waterfall), N 18° 42.970' E 102° 22.349', altitude *ca* 270 m, 26 August 2014, CP 260814–1 (BK–holotype; MSU–isotype).

Lithophytic, perennial herbs, slender; rhizome short, with fibrous roots and some form the long storage tubers. Pseudostems (5.5–)12.2–27.4 cm, hairy, with longitudinal reddish green stripes blade sheaths; bladeless sheath 1–2, hairy, some with reduced lamina; ligule 3.2–5.4 mm long, apex acute, membranous, hairy. Leaves 5–11, subsessile, *ca* 5 mm long; leaf blade lanceolate, largest one 7.1–13.5 × 1.8–2.7 cm, apex acute to acuminate, base cuneate, glabrous on both surfaces, greenish on the upper surface, greyish on the lower surface, margin reddish brown, undulate to wavy. Inflorescence terminal; peduncle 1.1–2.5 cm long, hairy, hidden in the upper most leaf sheath. Flowers yellow; bract (1)2–3(–4), some with a sterile bract, each bract subtending (2)–4–6(–8) flowers, blade lanceolate to ovate, 2.5–4.2 × 1.5–2.3 cm, apex acuminate, hairy, reddish brown, margin green. Bracteole broadly lanceolate, 2–5 × 2–4 mm, translucent. Calyx tubular, 0.7–1.2 cm × 2–3 mm, glabrous, translucent, split 3–5 mm down on one side, apex bifid. Corolla tube 2.6–3.8 cm × *ca* 2 mm, yellowish; dorsal corolla lobe oblong, 1.1–1.3 cm × 4–5 mm, yellowish, hooded with apex produced into *ca* 1 mm thorn-like point; lateral corolla lobes oblong, 1–1.3 cm × 3–4 mm, yellow, apex acute.

Lateral staminodes patent, obovate, $1.4\text{--}1.7 \times 0.8\text{--}1$ cm, yellow, apex emarginated. Labellum obovate to broadly obovate, $1.9\text{--}2.3 \times 1.6\text{--}2.1$ cm, median lobe emarginate, apex undulate, yellow. Filament very short, *ca* 1 mm long; anthers $2\text{--}3$ mm long; anthers crest suborbicular, $3\text{--}4 \times 4\text{--}5$ mm, apex rounded, yellow. Ovary oblong to ovate, $2\text{--}3 \times ca$ 2 mm, glabrous, greenish; stylodial glands 2, *ca* 1 mm long. Fruit fleshy capsule, oblong, $0.6\text{--}1.3$ cm \times $4\text{--}6$ mm, greenish. Seeds ellipsoid *ca* 2 mm long, numerous, crowned with whitish arillode.

Phenology: Flowering August–September; fruiting September–October.

Distribution: Lao PDR, Vientiane Province, Hin Herb District, Phou Meut–Phou Kiykon Forest Conservation, so far known only from the type locality.

Ecology: This new species grows on moist mossy red sandstones in waterfalls under the shade of deciduous forest at the altitude of 250–400 m.

Etymology: The senior author and the first author decided to name this new species after Dr. Boonmee Phokham who has contributed to the studies of the genus

Caulokaempferia for more than a decade. He had described new species of the genera *Kaempferia* and *Caulokaempferia*. He had spent more than three consecutive years traveling with the first and third authors to remote areas in Lao PDR in search for the *Caulokaempferias*.

Additional specimens examined: LAO PDR. Vientiane Province, Hin Herb District, Phou Meut–Phou Kiykon Forest Conservation, Ban Hoiuy Dokmai (Hoiuy Dokmai Waterfall), 6 September 2014, CP 060914–1 (MSU).

Note: The hairy pseudostem with reddish green longitudinal stripes are easily distinguished from other related taxa. Although the distal median lobe of the labellum are common character among several taxa distributed along the Mekhong River, the hairy bract and peduncle, together with the reddish brown leaf margin, are also characteristic to this new species.

Molecular study of this new taxon supports that *C. phokhamii* is phylogenetically distinct taxon, and closed to *C. jirawongsei* Picheans. & Mookamul, *C. phuwoensis* Picheans. & Koonterm, and *C. phutokensis* Picheans. result of which will be published in the forthcoming publication.

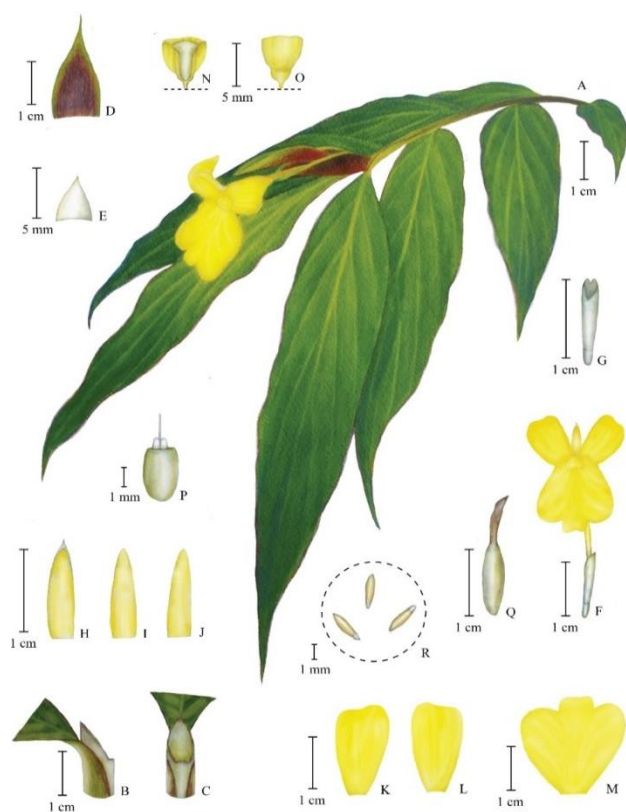


Fig. 1. *Caulokaempferia phokhamii* Picheans. & Douangde. A: plant showing habit, leaves, and inflorescence; B and C: part of a leaf, showing ligules (B. Side view, C. Front View); D: bract; E: bracteole; F: flower showing calyx tube, lateral staminodes and labellum; G: calyx tube and ovary; H: dorsal corolla lobe; I and J: lateral corolla lobes; K and L: lateral staminodes; M: labellum; N and O: anthers and anther crests (N. Front View, O. S; P: ovary and stylodes; Q: fruit with persistent calyx; R: seeds. (Drawn by Chalermchoke Boonchit).

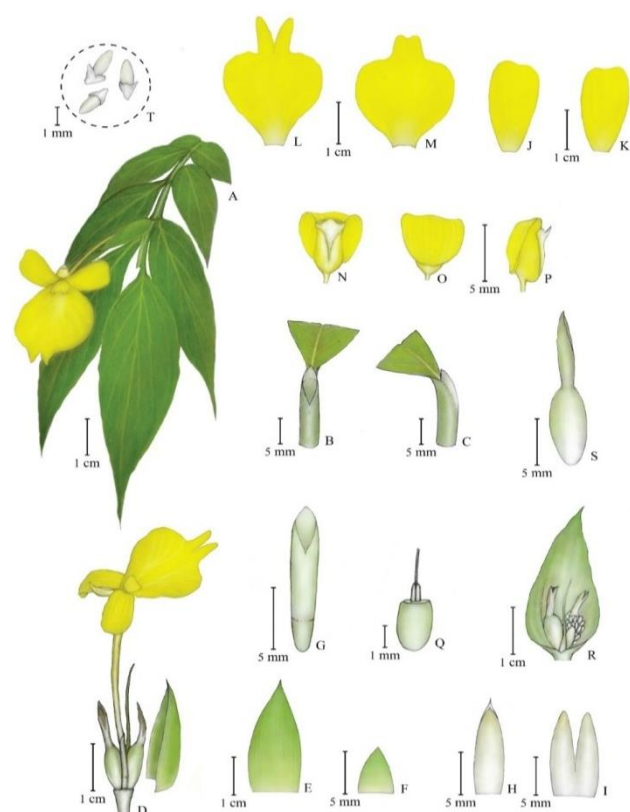


Fig. 3. *Caulokaempferia wongsuwaniae* Picheans. & Douangde. A: plant showing habit, leaves, and inflorescence; B and C: part of a leaf, showing ligules; D: flower with fruits and a bract; E: bract; F: bracteole; G: calyx tube and ovary; H: dorsal corolla lobes; I: lateral corolla lobes, J and K: lateral staminodes; L and M: labella; N, O and P: anthers and anther crests (N: front view side, O: rear view side, and P: right view side); Q: ovary and stylodes; R: top view of a bract showing fruits and seeds; S: fruit with persistent calyx; T: seeds. Drawn by Chalermchoke Boonchit.

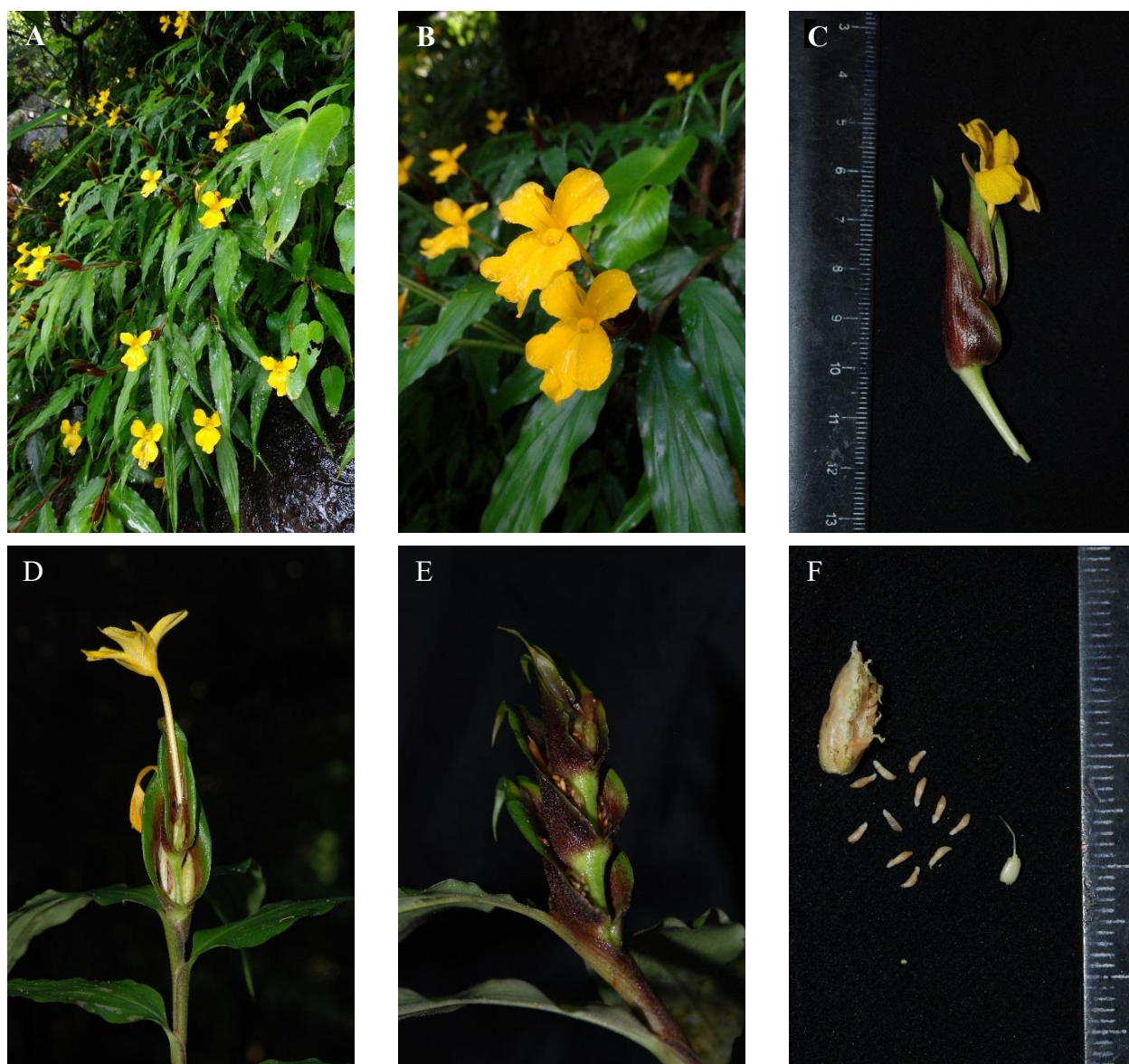


Fig. 2. Photographs of *Caulokaempferia phokhamii* Picheans. & Douangde.

A: plant in location; B: plants, showing leaves and flowers; C: inflorescence; D: inflorescence, showing bracts with a flower and young fruits; E: infructescence with seeds; F: ovary with stylodes, fruit and seeds. (Photographed by Pornpimon Wongsuwan).

2. *Caulokaempferia wongsuwaniae* Picheans. & Douangde., *sp. nov.* (Figs. 3–4)

This new species is similar to *Caulokaempferia jirawongsei*, but differs in the following characters: (1) Pseudostem shorter (3.3–7.6 cm vs 15.1–31.4 cm), (2) ligule shorter (ca 3 mm vs. 0.6–1 cm) and hairy, (3) Flower per bract (1–)2–3, (4) Corolla lateral lobe oblong and fused at lower base and (5) Labellum obovate to broadly obovate with median lobe, each lobe emarginate or bilobed.

Type: LAO PDR. Bolikhamxai Province, Mueang Tha Pabad District, Nam Tok Tad Mangkorn, N 18° 25.997' E 103° 12.12.544', altitude ca 200 m, 20 September 2014. CP 200914–1 (BK–holotype; MSU–isotype).

Epilithic perennial herbs, slender, rhizome short or long with fibrous root. Pseudostems 3.3–7.6 cm, with 2–3 bladeless sheath or reduced lamina; ligules deltoid to

oblong, 3 mm long, apex acute, membranous, hairy. Leaves 6–8, petiole 1–5 mm long; leaf blade broad lanceolate to ovate, 5.5–9.6 × 1.3–2 cm, lower leaf surface glandular, two upper most ones the largest. Inflorescence terminal; peduncle 3–8 cm long, glabrous. Flowers yellow; bract 1(–2), glandular sometimes secondary bract fertile, lanceolate to ovate, (1–)2–3 flowers per bract; bracteole triangular, apex acute, glabrous. Calyx tubular, 5–7 mm long, apex acute. Corolla tube 3.1–3.4 cm long; dorsal corolla lobe oblong, 1–1.1 × 0.3–0.4 cm, yellow, hooded, apex acute; lateral corolla lobe oblong, 8–9 × ca 3 mm long with fused at lower base, apex obtuse. Lateral staminodes patent, obovate, 1.2–1.6 × 0.6–1 cm, apex rounded to emarginate. Labellum obovate to broadly obovate, 1.8–2.3 × 1.7–2 cm, median lobe emarginate or bilobed. Filament short, anther crest oblong ca 2 mm long, apex rounded, glabrous. Ovary oblong, ca 2 × 1 mm, glabrous, stylodes 2, ca 1 mm long, stigma cup shape, ciliated. Fruit ellipsoid, 4–5 × 2–3 mm, glabrous. Seeds oblong, ca 1 × 0.5 mm.



Fig. 4. Photographs of *Caulokaempferia wongsuwaniae* Pichens. & Douangde.

A: plant in type location; B and C: plants showing habit, leaves and flowers; D: flower showing staminodes, labellum and anther crest; E: plant showing leaves and infructescence with young fruits; F: fruits with persistent calyx and seeds. Photographed by Boonmee Phokham.

Phenology: Flowering August–September; fruiting September–October.

Distribution: Lao PDR. Tad Mangkorn Waterfall, Phou Kua Kua forest Conservation, Mouang Tha Pabad District, Bolikhamxay Province.

Ecology: On moist mossy rocks nearby or in stream. Habit lithophytic herbs sandstone clefts and rocks facing the waterfalls and on the rock in the waterfalls, under the shade of moister evergreen forest.

Etymology: The senior author and the first author decided to name this new species after Assistant Professor Pornpimon Wongsuwan who has contributed to the studies of the family Zingiberaceae for more than a decade. She had described new species of the genera *Hedychium*, *Kaempferia* and *Caulokaempferia*. She had spent more than three consecutive years traveling with the

first and second authors to remote areas in Lao PDR in search for the *Caulokaempferias*.

Additional specimens examined: LAO PDR. Bolikhamxai Province, Mueang Tha Pabad District, Dan Khee Ling, 23 September 2014. CP 230914–1 (MSU).

Notes: Morphologically, this species is similar to *Caulokaempferia jirawongsei* but differs in the following characters: Pseudostem 3.3–7.6 cm long, ligule deltoid to oblong, membranous, 3 mm long, hairy, each bract subtends (1)–2–3 flowers, corolla lateral lobe oblong and fused at lower base and labellum obovate to broadly obovate with median lobe, each lobe emarginated or bilobed.

With these 2 new species, *Caulokaempferia phokhamii* and *C. wongsuwaniae*, a total of 4 taxa are enumerated for Lao PDR. All taxa are endemic to Lao PDR and can be readily identified by the following key.

Key to the genus *Caulokaempferia* in Lao PDR.

1. Bract and inflorescence axis glabrous	1. <i>C. bolavenensis</i>
1. Bract and inflorescence axis hairy, or with glands	2
2. Bract hairy, reddish brown	2. <i>C. phokhamii</i>
2. Bract with gland, greenish	3
3. Bract 1(-2), each bract subtending (1-)2-3 flowers	3. <i>C. wongsuwaniae</i>
3. Bracts 1-4(-5), each bract subtending 5-6 flowers	4. <i>C. bracteata</i>

Table 1. Morphological comparison of *Caulokaempferia jirawongsei*, *C. phokhamii* and *C. wongsuwaniae*.

Characteristic	<i>C. jirawongsei</i>	<i>C. phokhamii</i>	<i>C. wongsuwaniae</i>
Pseudostem	15.1-31.4 cm long	(5.5-)1.2-27.4 cm long, hairy with reddish green striped	3.3-7.6 cm long
Leaf			
Bladeless sheath	2-3	1-2, hairy	2-3
Shape	lanceolate, 9.5-12.4 × 1.8-2.3 cm, both surfaces glabrous, margin entire to slightly undulate	lanceolate, 7.1-13.5 × 1.8-2.7 cm, both surface glabrous, upper greenish, lower grayish, margin undulate to wavy with reddish brown	broadly lanceolate to ovate 5.5-9.6 × 1.3-2 cm lower leaf surface with glandular
Ligule	6-10 mm long	3.2-5.4 mm long, hairy	3 mm long, hairy
Inflorescence			
Peduncle	1.7-2.3 cm long	1.1-2.5 cm long, hairy	3-8 mm long
Bract	1-4(-5), lanceolate, glabrous, 2.7-3.5 × 1.3-1.6 cm, apex acuminate, margin free to the base, axis partially visible on one side	(1-)2-3 (-4) some with a sterile bract, lanceolate to ovate, 2.5-4.2 × 1.5-2.3 cm, hairy, reddish brown, margin green, apex acuminate	1(-2) with fertile bract, lanceolate to ovate, glandular, sometimes 2nd bract fertile
Flower per bract	5-6	(2-)4-6(-8)	(1-)2-3
Flower			
Calyx tube	0.8-1.0 cm long, translucent, split 2-3 mm down one side, glabrous, apex rounded	0.7-1.2 cm long translucent, split down one side, apex bifid	5-7 mm long, apex acute
Dorsal corolla lobe	triangular, ca 1 × 0.3 cm, hooded with apex produced into a 0.5 mm thorn-like point	oblong, 1.1-1.3 cm × 4-5 mm, hooded, apex apiculate	oblong, 1-1.1 × 0.3-0.4 cm, hooded, apex acute.
Lateral corolla lobe	triangular, ca 1.1 × 0.3 cm, apex obtuse, hooded	oblong, 1-1.3 cm × 3-4 mm, apex acute	oblong, 8-9 × ca 3 mm long, fused at lower base apex obtuse
Staminodes	patent, auriculate, elliptic-ovate, 1.4-1.6 × 0.7-1.1 cm, apex rounded to emarginate	patent obovate, 1.4-1.7 × 0.8-1 cm, apex emarginate	patent, obovate, 1.2-2.2 × 0.6-1.1 cm, apex rounded to emarginate
Labellum	flat and saccate base, distal 3-lobed with emarginate median lobe, 2.2-2.4 × 1.9-2.1 cm	obovate to broadly obovate with emarginate median lobe, apex undulate, 1.9-2.3 × 1.6-2.1 cm	obovate to broadly obovate, 1.8-2.6 × 1.7-2.0 cm, median lobe emarginate or bilobed
Anther crest	broadly ovate, ca 5 × 5-6 mm, slightly reflexed	suborbicular, 3-4 × 4-5 mm, apex rounded	oblong ca 2 × 3 mm apex rounded
Fruit	fleshy capsule, 0.8-1.5 cm long	oblong, 6-13 × 4-6 mm	ellipsoid, glabrous, 4-5 × 2-3 mm
Seed	ellipsoid, hairy, light brown, ca 2 mm long	ellipsoid ca 2 mm long with white aril	oblong, ca 1 × 0.5 mm

Acknowledgements

This research is financially supported (in part) by Maharakham University. The authors would like to thank members of our research group: Mr. Vongtakoun Somsamout, Mr. Khamphan Chanthapanya and Mr. Sengaloune Chaluersinh for field assistances and Mr. Chalermchoke Boonchit for the beautiful ink line-drawing with water color of these new species.

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(Received for publication 26 January 2018)