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Ceropegia laotica (Apocynaceae, Asclepiadoideae): the first new species of *Ceropegia* described from Laos

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ABSTRACT. A new species, *Ceropegia laotica* Rodda & Meve, from the Bolaven Plateau in southern Laos, is described and illustrated. It shows a twining habit, linear-lanceolate leaves and possesses small root tubers. The new species is compared with *Ceropegia cochleata* Kidyoo from Thailand.

Keywords. *Ceropegia cochleata*, *Ceropegia digitiformis*, Ceropegieae, Indochinese Peninsula, Southeast Asia

Introduction

In the traditional, morphology-based circumscription of *Ceropegia* L. the genus includes only taxa possessing pitfall flowers that trap small visiting flies for 24 hours in funnel-shaped, basally inflated corollas. Molecular-based studies have shown, however, that the phylogeny of the terminal branch of the tribe Ceropegieae, the Stapeliinae, to which *Ceropegia* belongs, is complex. The other genera of Stapeliinae (*Brachystelma* R.Br. and the stapeliads) are all nested and scattered through the *Ceropegia* tree, making *Ceropegia* multiply paraphyletic (Meve & Liede-Schumann, 2007; Surveswaran et al., 2009; Bruyns et al., 2015). These studies have documented that complex pitfall flowers – always thought to represent the peak of evolution in the Ceropegieae – have been independently lost several times during evolution to be replaced by open, radiate flowers. However, in order to prevent severe taxonomic instability in an extremely species-rich group (Stapeliinae comprises around 700 species), Meve & Liede-Schumann (2007) suggested that paraphyly in *Ceropegia* / Stapeliinae be accepted and that the "*Ceropegia* pitfall flower" be retained as a diagnostic character for *Ceropegia*. However, recently, Bruyns et al. (2017) proposed about 400 new names and combinations in *Ceropegia* in order to make it monophyletic. As long as the driving forces of the complex evolution in this group are not at least minimally understood, we prefer to retain the traditional classification, keeping *Brachystelma* and the stapeliad genera separate. There are around 210 "true" *Ceropegia* species of small erect or twining herbs which occur widely in the Old World tropics and subtropics of

Southeast Asia, India, Arabia, Africa, Madagascar, reaching east to New Guinea and Northern Australia and west to the Canary Islands (with two species). The diversity within *Ceropegia*, its wide distribution, and the attractive flowers were and are fascinating. Many floristic, often geographically focused works, have been produced for places such as India (Hooker, 1883; Ansari, 1984), China (Li et al., 1995), Arabia (Bruyns, 1988), Madgascar (Meve & Liede, 1994), Southern Africa (Dyer, 1980), and Tropical East Africa (Masinde, 2012). Only one complete revision of the genus has been undertaken (Huber, 1957), although a wide-ranging treatment (lacking the non-succulent taxa) was published more recently by Meve (2002). China (Li et al., 1995) and India (Ansari, 1984) are by far the diversity hotspots in Asia. Without doubt Asia is the centre of origin of *Ceropegia* (Bruyns et al., 2015; Meve et al., 2017). In Southeast Asia, however, the number of taxa is considerably lower. Myanmar has nine species, according to the last compilation by Kress et al. (2003) and the inclusion of *Ceropegia farrokhii* McCann in *C. kachinensis* Prain by Singh et al. (2015), and in Vietnam just three species are recorded (Costantin, 1912; Vietnam Plant Data Center: http://www.botanyvn.com). However, recent research on *Ceropegia* in Thailand has led to the discovery of numerous new species bringing the count for the country to ten (Kerr, 1951; Boonjaras & Thaithong, 2003; Meve, 2009; Kidyoo, 2014a, 2014b, 2015a, 2015b; Kidyoo & Paliyavuth, 2017). Finally, in Laos, only one unidentified *Ceropegia* species has so far been recorded (Newman et al., 2007). Recent fieldwork in southern Laos by the first author has now led to the discovery of an unknown species of *Ceropegia* that is here described and illustrated as a new taxon.

Taxonomy

Ceropegia laotica Rodda & Meve, **sp. nov.**
Similar to *Ceropegia cochleata* Kidyoo in trailing to twining annual growth habit, presence of small tubers, leaves more or less lanceolate and small, and in habitat preferences: sandstone rocks with sparse soil. *Ceropegia laotica* can be separated from *C. cochleata* because the former has corolla lobes broadly ovate and folded while the latter has corolla lobes long-tailed and twisted. – TYPE: Laos, Champasak Province, Paksong, Dong Hua Sao NBCA, Bolaven Plateau, Ban Hnongluang Wat, 15°07′57″N 10°20′57″E, 1258 m, 23 October 2015, *Rodda, M., Tan, L., Guglielmone, L., Peereman, J.M.E., Souvannaphou, S. & Soulimoungichoun, O. MR1418* (holotype SING; isotypes FOF, Herbarium of Pha Tad Ke Botanic Garden, TO). (Fig. 1, 2)

Perennial climbing herb with 1 or 2 stems from the base, twining, with clear sap in all parts. ***Rootstock*** tuberous; tubers subglobose, slightly apically compressed, smooth, medium brown, 2–3 cm in diameter, with many additional, straight, fleshy ***roots***. ***Stems*** rarely branched, terete, glabrous, to 2 m long, 1.5–2.5 mm in diameter, greenish red to maroon red; internodes (3–)5–10(–15) cm long. ***Leaves*** spreading, petiolate, ***petiole*** terete, slightly channelled above, 5–7 × 1–1.5 mm in diameter, pubescent only above, trichomes curved, 100–200 μm long; ***lamina*** linear(-lanceolate), (4–)5–

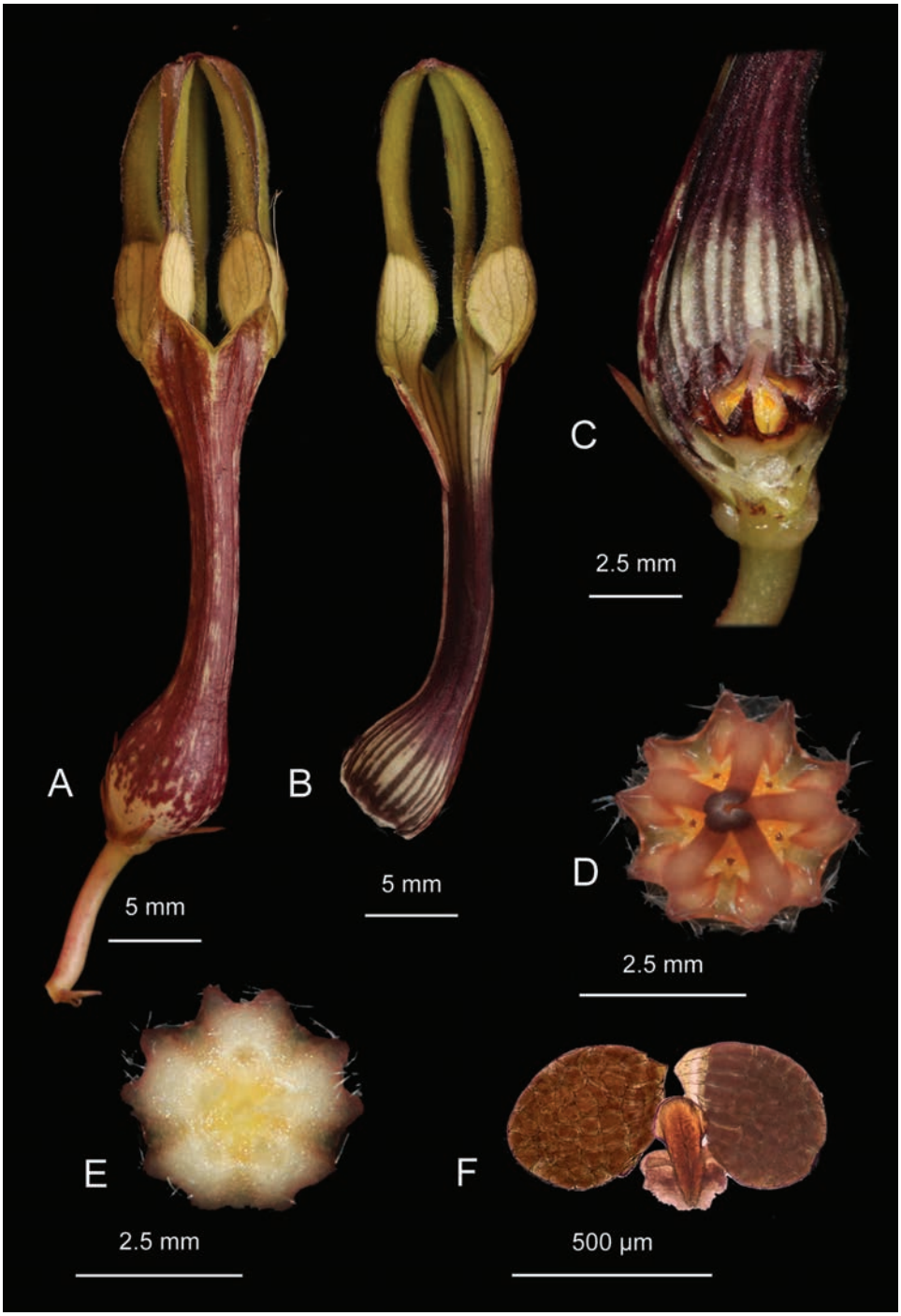

Fig. 1. *Ceropegia laotica* Rodda & Meve. **A.** Single flower. **B.** Corolla, longitudinal section with corona removed. **C.** Corona, side view. **D.** Corona, top view. **E.** Corona, from underneath. **F.** Pollinarium. A–C & F based on *M. Rodda et al. MR1418*, D, E based on *M. Rodda et al. MR1802*. (Photos: M. Rodda)

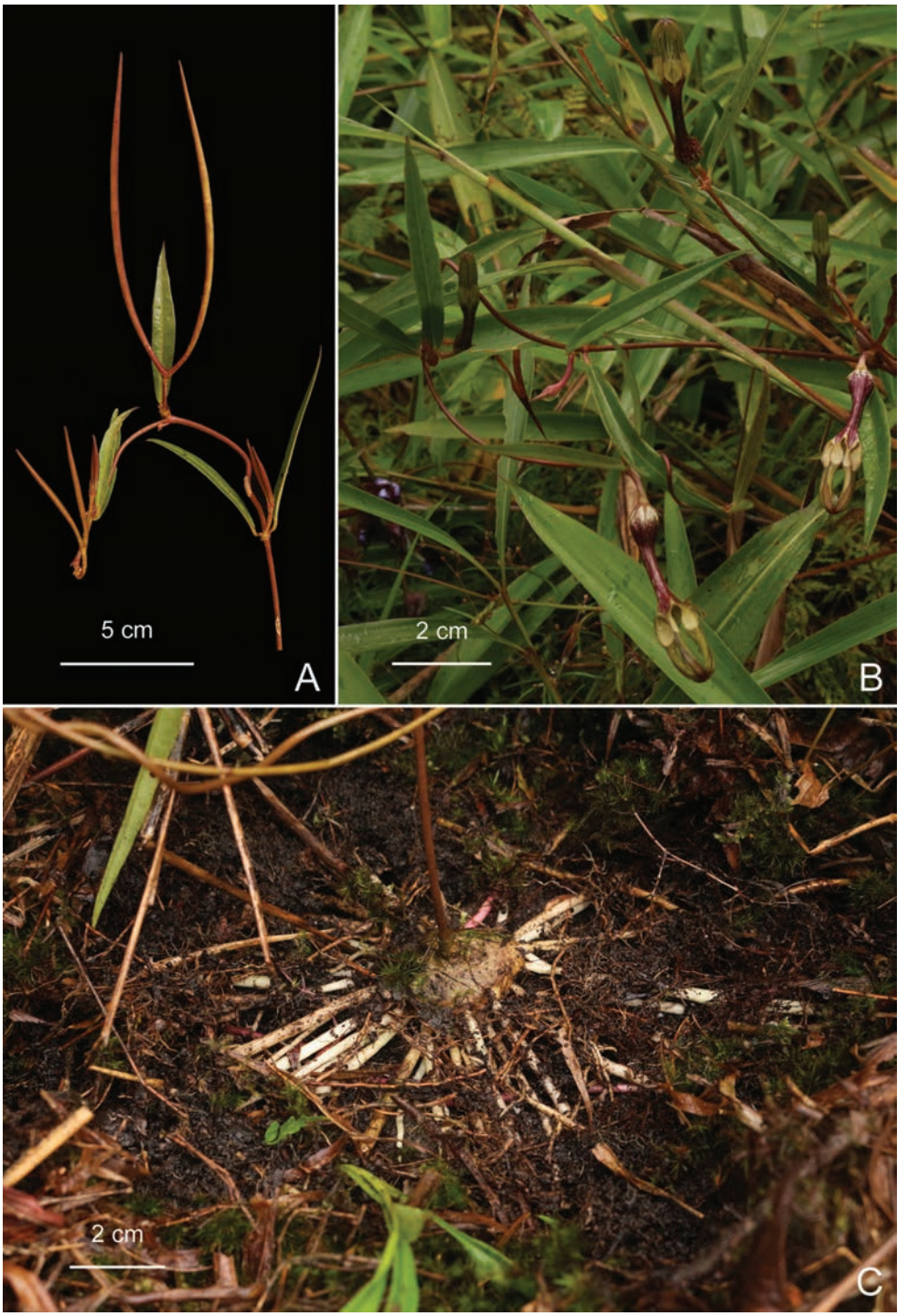

Fig. 2. *Ceropegia laotica* Rodda & Meve. **A.** Fruiting branch. **B.** Plant *in situ*, climbing over bamboo. **C.** The exposed tuber and roots after removing a thin layer of leaf litter. (Photos: M. Rodda)

10(–12) × 0.5–1.2 cm, slightly fleshy but flexible, base attenuate, apex acute, pale green above, paler underneath, sparsely pubescent above, underneath pubescent along main vein only, trichomes curved, 100–200 µm long, older leaves glabrous; venation pinnate, lateral veins obscure; ***colleters*** 1 or 2 at base of lamina, globose, 200–300 µm in diameter. ***Inflorescences*** 1–2 flowered, with only one flower open at a time, ***peduncles*** extra-axillary, one per node, 0.5–2 × 1.5–2 mm in diameter, reddish green, glabrous; pedicels erect, 8–15(–25 when fruiting) × c. 1.5 mm in diameter, reddish green to whitish, glabrous or very sparsely pubescent; bracts 1 or 2 at base of pedicel, lanceolate, 1–2 mm long, reddish, apex acute. ***Calyx*** lobes narrowly lanceolate, 4–5 × 0.7–1 mm, glabrous, apex acuminate, reddish, glabrous; with one colleter at each sinus, conical, 400–500 × 150–200 µm, acute. ***Corolla*** 35–45 mm in total length, ***tube*** upright, straight or slightly curved, glabrous, with a bulbous base, a cylindrical mid portion and funnel shaped apex; tube (20–)23–27 mm long, base 5–7 mm in diameter, cylindrical part 2.5–3.5 mm in diameter; base white and densely spotted red outside, inside white and striped red; cylindrical part red with paler dots outside, dark red and striped maroon inside; apex red and spotted green outside, cream and striped green inside; ***corolla lobes*** broadly ovate, folded, (12–)15–17 × 7–8.5 mm, basal part cream-yellow, ciliate, apex acute, connate at tips, green and pubescent and ciliate inside, maroon red and glabrous outside. ***Gynostegium*** stipitate, stipe 0.4–1.6 × 0.9–1.1 mm in diameter, white, glabrous. ***Gynostegial corona*** of staminal and interstaminal parts, interstaminal lobes joined to form a shallow cup, 4.5–5 mm in diameter, purple with a white base; free lobes deeply bifid with the tips of adjacent lobules touching each other, ascending-erect, small triangular, c. 1.5 × 1 mm, maroon red, inside pilose with spreading translucent-white trichomes c. 0.5 mm long, staminal corona lobes connivent-erect, linear, terete, 1–1.2 × 0.25–0.35 mm, pinkish white. ***Pollinaria*****:** pollinium broadly ovoid, yellow, 350–400 × 350–400 µm, caudicles c. 200 µm long, corpusculum clavate, reddish brown, 250–300 × 90–110 µm. ***Ovary*** narrowly conical, 2.1–2.3 × 0.5–0.7 mm wide at the base, apex truncate, glabrous. ***Mericarps*** held erect, linear, slightly curved, c. 11.5 × 3 mm (immature), reddish green. ***Seeds*** not seen.

Distribution. Laos, Champasak Province, in the vicinity of Ban Hnongluang Wat.

Habitat and ecology. *Ceropegia laotica* is a perennial tuberous herb found in a single population where all individuals were rooted in very thin soils (3–6 cm thick) over large sandstone boulders partially exposed. The plants were growing among grasses and climbing over gingers, bamboo and *Ficus* spp. at the edge between open grassland vegetation and short stunted forest (Fig. 3).

Provisional IUCN conservation assessment. Endangered EN B1ab(iii) + B2ab(iii) using the guildelines from the IUCN Standards and Petitions Subcommittee (2017). *Ceropegia laotica* is known only from the type locality. A thorough survey of the Bolaven Plateau is lacking and we have little information on similar habitats in neighbouring Thailand and Vietnam for a conclusive conservation assessment. If, however, we estimate the EOO as the entire Bolaven Plateau (< 5000 km^2) and

Fig. 3. The habitat of *Ceropegia laotica* Rodda & Meve in the vicinity of Ban Hnongluang Wat, Laos. Open grassland vegetation on very thin soils with exposed bedrock. (Photo: M. Rodda)

consider that only a small part of it has suitable rocky habitat for the species (AOO < 500 km^2) and also take into account that the area is heavily affected by habitat loss due to land conversion to agriculture, mining and dams (Delang et al., 2013), a provisional conservation status can be assessed as endangered pending more information which might increase the threat status further.

Additional specimens examined. Ceropegia laotica. Cultivated plant grown on from Laos, Champasak Province, Paksong, Dong Hua Sao NBCA, Bolaven Plateau, Ban Hnongluang Wat, 15°07′57″N 10°20′57″E, 1258 m, 23 October 2015, *Rodda, M. et al. MR1418*, vouchered at Singapore Botanic Gardens on 16 May 2017 as *Rodda, M. MR1802* (SING).

Notes. The type of *Ceropegia thorelii* Constantin was collected from the border region of Cambodia and Laos. It was treated by Huber (1957) as *Ceropegia macrantha* Wight var. *thorelii* (Constantin) H.Huber and is a lowland species only reported from St(e)ung Treng (Cambodia, Mekong River). The type specimen in P (*Thorel 2148*) is a fairly sturdy plant with elliptical leaves, pedunculate inflorescences and a corolla which is coarsely brownish spotted. Hence, Huber (1957) placed it in *Ceropegia macrantha* despite its hairy peduncles and pedicels, as did Meve (2002) who included *C. thorelii* as a full synonym of *C. macrantha*. Interestingly, a later collection made at Steung Treng (cf. Maxwell, 2009: fig. 14) has a corolla superficially comparable to the type of *C. thorelii*, but the stems and leaves are densely pilose, the leaves seem to be rather

small and, most importantly, the basal inflation of the corolla tube (ostiolum) is basally constricted. This latter character is significant and of high taxonomic value in, for example, African *Ceropegia*. Therefore, Maxwell´s (2009) determination as *C. thorelii* cannot be confirmed here. Instead, although the corolla of *Ceropegia cochleata* Kidyoo, with its long-tailed, twisted lobes, does not show much similarity with the relatively short and obtuse corolla lobes of the new species, *Ceropegia cochleata* and *C. laotica* are vegetatively, ecologically and geographically much closer. They share the trailing to twining (when support is available) habit and growth form; they have wiry stems and spreading, fairly small, more or less lanceolate leaves; they have similar habitat preferences as they both occur on sandstone rocks with sparse soil and vegetation cover dominated by grasses and mosses (Kidyoo, 2015b); both species develop small tubers; and the above-ground parts do not survive the dry season.

There are also a number of similarities in habit, ecology and flower morphology between *Ceropegia laotica* and *C. digitiformis* Kidyoo. The latter species is found in Thailand in the Phu Wua Wildlife Sanctuary and Phu Langka National Park, c. 400 km northwest of the type locality of C. laotica. However, although *Ceropegia digitiformis* is also deciduous, the aerial stems survive the dry season because they are fleshy (Kidyoo & Paliyavuth, 2017), and not wiry as in *C. laotica*. Also the leaves are laminar, elliptic, ovate to rounded in *Ceropegia digitiformis* (and not rather linear and fleshy as in *C. laotica*) – displaying a close relationship to the Indian *C. thwaitesii* Hook. Kidyoo & Paliyavuth (2017) distinguish *Ceropegia digitiformis* from *C. thwaitesii* only on small deviations in corona morphology. In addition, *Ceropegia digitiformis* is unlikely to be a sister species of *C. laotica* because of the pollinarium morphology. The shape of the pollinium in *Ceropegia digitiformis* is ovoid with the germination crest subapical (cf. Kidyoo & Paliyavuth, 2107: figs. 1F and 2E), whereas the pollinia in *C. laotica* (and *C. cochleata*) are broadly ovate to (sub)rectangular with the pellucid margin along the inner side of the pollinium (Fig. 2f). On the other hand, *Ceropegia digitiformis* and *C. laotica* share the character of a stipitate corona although the interstaminal lobules in *C. laotica* are not linear-lanceolate as in *C. digitiformis*, but rather triangular and much more similar to those of *C. cochleata*, including in indumentum.

To conclude, *Ceropegia laotica*, *C. cochleata* and *C. digitiformis* all inhabit rocky, montane habitats on sandstone with sparse vegetation in the central Indochinese Peninsula. They share a number of morphological similarities but can each be distinguished by unique morphological characters. In the important habit, leaf and corona/gynostegial characters, we regard *Ceropegia cochleata* as presumably most closely related to our new species.

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