Tropical Natural History 21(1): 1–11, April 2021
©2021 by Chulalongkorn University

Two New Species of *Ceropegia* (Apocynaceae, Asclepiadoideae) on Limestone Hills in Northern Thailand

MANIT KIDYOO

Plants of Thailand Research Unit, Department of Botany, Faculty of Science, Chulalongkorn University, Pathumwan, Bangkok 10330, THAILAND
*Corresponding author. Manit Kidyoo (kidyoo_m@yahoo.co.th)
Received: 4 August 2020; Accepted: 8 December 2020

ABSTRACT.– Two new lithophytic climbers with clustered fusiform roots, *Ceropegia calcicola* Kidyoo and *C. thorutii* Kidyoo, from northern Thailand are here described. Illustrations, photographs, and comparisons of diagnostic characters with the morphologically similar species are provided.

KEY WORDS: *Ceropegia calcicola, C. thorutii*, section *Chionopegia*, section *Janthina*, twining herb

INTRODUCTION

Ceropegia sensu stricto (Linnaeus, 1753) (Apocynaceae, Asclepiadoideae) includes at least 200 species, distributed in Southeast Asia, India, Madagascar, tropical Arabia, Canary Islands, Africa, New Guinea and Northern Australia (Huber, 1957; Li et al., 1995; Meve, 2002, Thaithong et al., 2018; Kambale and Yadav, 2019). The genus has been revised several times, based mainly on molecular phylogenetic data and mostly with the African and Indian species examined (Bruyns et al., 2015, 2017; Endress et al., 2018). Following these studies, the genus *Ceropegia* is enlarged owing to the inclusion of the species of *Brachystelma sensu stricto* (Brown, 1822) and Stapeliads.

The genus *Ceropegia* as originally circumscribed is well characterized by flowers with connate corolla lobes that make them different from flowers of *Brachystelma*, forming an urceolate or tubular structure with swollen basal part topped by lobes of various forms that are united at tip to form a cage-like structure (Huber, 1957; Li et al., 1995; Meve, 2002). In Thailand, 20 species are known. They usually grow in sandy soils, open areas in the deciduous forests in northeastern and eastern Thailand (Thaithong et al., 2018; Suwannakote and Kidyoo, 2020). In recent years, two unknown *Ceropegia* species have been collected from limestone hills in northern Thailand. These plants have twinning stems arising from clustered fusiform roots. Morphologically and ecologically, they are somewhat similar to four known species found in southwestern and northern Thailand, i.e. *C. kachinensis* Prain, *C. mairei* (Léveillé) H. Huber, *C. siamensis* Kerr, and *C. thaithongiae* Kidyoo (Thaithong et al., 2018). However, these two unknown plants clearly differ in having glabrous leaves and pedunculate inflorescences. Examination of their morphological and ecological characteristics and comparison with those of the specimens of all known *Ceropegia* species in the herbaria BCU, BK, BKF, BM, K, L, QBG and P indicated that both plants are different enough to be separate species. Two new species are

hereby described and named as *C. calcicola* Kidyoo and *C. thorutii* Kidyoo. Detailed comparisons between the two new species and their respective similar species, *C. macrantha* Wight and *C. elegans* Wall. from India, are provided.

MATERIALS AND METHODS

Specimen collection and morphological studies were carried out during 2012–2018. Specimens of *Ceropegia* plants were collected from limestone hills in northern Thailand. Vegetative and repro-ductive structures of the fresh materials and the preserved specimens in the herbaria BCU, BK, BKF, BM, K, L, P and QBG were investigated and compared. Morphological traits of leaves and flowers were principally observed under light microscopy (LM).

RESULTS

SYSTEMATICS

Ceropegia calcicola Kidyoo **sp. nov.** (Figs. 1–2)

Ceropegia calcicola differs from the morphologically similar *C. khasiana* in having ovate leaves, entirely glabrous corolla and shallowly bifid interstaminal corona lobes. In contrast, *C. khasiana* has lanceolate or linear-lanceolate leaves, corolla tube with a ring of trichomes on the inside at the distal part of the swollen basal portion, corolla lobes that are puberulent on the adaxial surface, and deeply bifid interstaminal corona lobes. Type: Thailand, Chiang Mai, Chiang Dao Wildlife Sanctuary, 1600 m alt., 6 Sep. 2012, *M. Kidyoo 1561* (holotype BKF!; isotype BCU!).

Perennial, twining herbs, with latex. *Rootstock* a cluster of fusiform, succulent, light brown roots, 5–11 cm long, 0.2–0.4 cm in diameter. *Stems* and branches terete, glabrous, 1–2 m long, 1.2–2.5 mm in diameter, green when young, turning brown with age; internodes 7–14 cm long. *Leaves* opposite; petiole 1.1–2.0 cm long, 1.6–2.2 mm in diameter, adaxially grooved, glabrous, only puberulous along rims of the groove; blade membranous, ovate, 3.5–5 × 1.7–2.6 cm, apex acute to short acuminate, base acute to rounded or subcordate with 1–2 small colleters on the adaxial surface, margins entire to sparsely ciliate; adaxial surface green, glabrescent to sparsely puberulent, abaxial surface pale green, glabrous; veins 4–6 pairs, visible on both sides. *Inflorescences* extra-axillary, 3–5-flowered cyme; peduncle 0.3–1.5 cm long, 1–1.5 mm in diameter, glabrous; pedicels green or pinkish white, 1.3–1.8 cm long, 1.1–1.3 mm in diameter, glabrous; bracteoles subulate to lanceolate, 1–2 mm long, green to greenish brown, apex acuminate, glabrous. *Sepals* green or greenish brown, narrowly triangular, 2.7–3.2 × 0.9–1.1 mm, sharply acute at apex, glabrous. *Corolla* upright, slightly curved; corolla tube entirely glabrous, yellowish or pinkish white with brownish purple blotches throughout, 1.9–2.4 cm long, inflated at base, 5–6 mm in diameter and narrowing into a tube of 2.2–2.5 mm diameter, then gradually widening upwards, mouth of the tube 0.6–0.7 cm in diameter; its interior glabrous, maroon or reddish brown; lobes lanceolate, glabrous, 1.6–2.2 × 0.4–0.6 cm, apex acute to obtuse, apically connate and forming a narrowly conical cage-like structure, each lobe reduplicate from near the base, the wider proximal half white to pinkish white, with reddish pink thin lines and fine dots, the narrower distal half

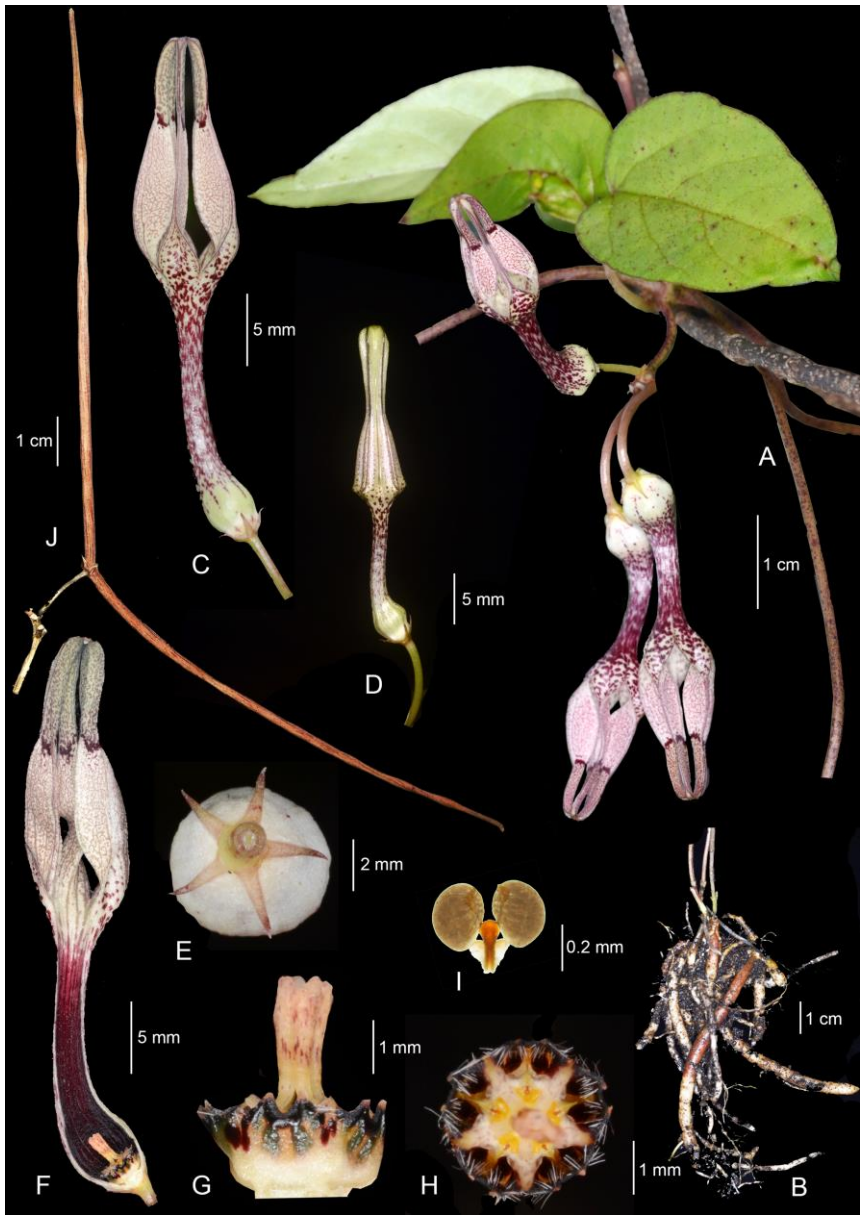

FIGURE 1. *Ceropegia calcicola* Kidyoo. A. Flowering branch. B. A cluster of fusiform roots. C. Open flower. D. Flower bud. E. Bottom view of flower showing calyx. F. Longitudinal section of flower showing corona and gynostegium. G. Side view of gynostegium and corona. H. Top view of gynostegium and corona. I. Pollinarium. J. Fruit. Photos by Manit Kidyoo from *M.Kidyoo 1561* (A-I) and *M.Kidyoo 1640* (J)

greenish to pinkish white, with brownish purple fine dots. *Gynostegium* sessile. *Corona* double; outer (interstaminal) corona formed by 5 lobes, basally joined to form a shallow cup, 3–3.5 mm in diameter, yellow, apex of lobes shallowly bifid, segments short

FIGURE 2. Habitat and habit of *Ceropegia calcicola* Kidyoo. A-B. Chiang Dao Wildlife Sanctuary, Chiang Mai province. C-D. Doi Pha Klong National Park, Phrae province. Photos by Manit Kidyoo

triangular, 0.2–0.3 mm long, apex acute, purple to dark purple and covered with white trichomes; inner (staminal) corona formed by 5 lobes, linear-spathulate, 2.4–2.7 mm long, 0.4–0.5 mm in diameter, yellowish to pinkish white, proximal part incumbent

upon dorsal surface of anthers, distal part connivent-erect, apex obtuse. *Pollinaria* 5; pollinium broadly ovoid, yellow, 0.33–0.35 × 0.22–0.25 mm, translator arms short, ca. 0.1 mm long, corpusculum spathulate, reddish brown, 0.24–0.26 × 0.11–0.13 mm. *Follicles* usually 2, linear-lanceolate in outline, 10–11 cm long, 0.3–0.4 cm in diameter, green when young, turning reddish brown with age. *Seeds* oblong, 7–8 × 2–2.5 mm, brown; coma ca. 1.5 cm long, silky white.

Thailand.– NORTHERN: Chiang Mai [Chiang Dao district, Chiang Dao Wildlife Sanctuary, 1600 m alt., 6 Sep. 2012, *Kidyoo 1561* (**BCU, BKF**); 29 Nov. 2015, *Kidyoo 1640* (**BCU**)]; Phrae [Sung Men district, Doi Pha Klong National Park, 350 m alt., 19 Sep. 1999, *Srisanga & Puff 1113* (**BKF, QBG**); 360 m alt., 28 July 2018, *Kidyoo 1669* (**BCU**)]; Prayao [Chiang Kham district, Doi Pha Chor, Tham Pha Daeng, 712 m alt., 16 Aug. 2013, *La-ongsri et al. 3059* (**QBG**)].

Etymology.– The specific epithet '*calcicola'* refers to limestone hill, the usual habitat of this plant.

Ecology and distribution.– *Ceropegia calcicola* is endemic to Thailand, occurring on limestone rock in shady to open areas on limestone hills at 350–1600 m alt. It usually grows inside rock cracks or rock pools where humus soil has collected. Its branches climb up small shrubs or cliffs. Flowering occurs from July to October.

Conservation Status.– *Ceropegia calcicola* is known from three conservation areas in northern Thailand. However, the number of individuals in each of these populations and the presence of plants in other conservation areas remains underexplored. Following the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2017), *C. calcicola* should be considered as Data Deficient (DD).

Notes.– *Ceropegia calcicola* is similar to *C. khasiana* Murug., A.A.Mao, Meitei & Kambale and *C. macrantha* Wight, which belong to the section *Chionopegia* H.Huber (sensu Bruyns et al., 2017). This section comprises about 23 species occurring in Pakistan, Nepal, Bhutan, India and China (Huber, 1957; Bruyns et al., 2017; Kambale and Yadav, 2019; Murugesan et al., 2019). *Ceropegia calcicola* and related species have several morphological traits in common that make them different from other species in the section, i.e. twining stems, slender corolla tubes with inflated bases, and lanceolate corolla lobes that are nearly as long as corolla tube. *Ceropegia macrantha* is clearly distinguished from the others by its flower characters. It has large flowers, corolla tube with strongly inflated basal portion and interstaminal corona lobes with bifid apices of which each segment is linear (nearly as long as staminal corona). By contrast, the flowers of *C. calcicola* and *C. khasiana* are smaller. Their flowers are characterized by a slightly inflated basal portion and interstaminal corona lobes with bifid apices of which each segment is triangular (shorter than half the length of staminal corona). In turn, these two species clearly differ from each other in leaves and flower characters. *Ceropegia calcicola* has ovate leaves, glabrous corolla and shallowly bifid interstaminal corona with short triangular segment lobes. *Ceropegia khasiana*, on the other hand, has lanceolate or linear-lanceolate leaves, corolla tube with inner surface, at the top of the inflated portion, being covered with a ring of trichomes. Its corolla lobes are puberulent inside and its interstaminal corona lobes are deeply bifid with narrowly triangular or triangular-lanceolate segments (Table 1).

TABLE 1. Morphological comparison of the new species and its similar species

Characters	*C. calcicola*	*C. khasiana* *	*C. thorutii*	*C. elegans***
stem	glabrous	sparsely puberulent (rarely glabrous)	glabrous	glabrous
lamina	ovate, 3.5–5 × 1.7–2.6 cm, glabrescent to sparsely puberulent on adaxial surface	lanceolate or linear-lanceolate, 5–15 × 0.5–2 cm, puberulent on adaxial surface	broadly ovate, 4–7.9 × 2.4–5 cm, glabrous on both surfaces	ovate, ovate-oblong, 5.3– 10 × 4–6 cm, glabrous on both surfaces
corolla tube	slightly curved, inflated at base, glabrous inside	slightly curved, inflated at base with a ring of trichomes on the inner surface at top of the inflated portion	strongly curved, slightly inflated at base, glabrous inside	strongly curved, strongly inflated at base with a ring of trichomes on the inner surface at top of the inflated portion
corolla lobes	lanceolate, glabrous on both surfaces, apically connate forming a narrowly conical cage-like structure	lanceolate or ovate-lanceolate, puberulent on adaxial surface, apically connate forming a narrowly conical cage-like structure	ovate-triangular, glabrous on both surfaces, apically connate forming a subglobose cage-like structure	ovate-triangular, glabrous on both surfaces, apically connate forming a subglobose cage-like structure
interstaminal corona lobes	shallowly bifid, with short triangular segments, erect and shorter than half the length of staminal corona	deeply bifid, with narrowly triangular or triangular-lanceolate segments, erect and shorter than half the length of staminal corona	shallowly bifid, with triangular-lanceolate segments, erect and about half the length of staminal corona	deeply bifid, with linear segments, erect and of nearly equal length to staminal corona
staminal corona lobes	linear-spathulate	linear-lanceolate	spathulate-clavate	linear

Ceropegia thorutii Kidyoo **sp. nov.** (Figs. 3–4)

Ceropegia thorutii is similar to *C. elegans* in having pedunculate cyme, strongly curved corolla tube being inflated at base, broadly ovate-triangular corolla lobes shorter than corolla tube and joined at tips forming a subglobose dome, but can be distinguished by its glabrous corolla tube being slightly inflated at base, bifid interstaminal corona lobes with triangular segments being shorter than half the length of the staminal corona lobes, and spathulate-clavate staminal corona lobes. Type: Thailand, Chiang Mai, Fang District, Doi Ang Kang, 1600 m alt., 29 July 2012, *M. Kidyoo 1552* (holotype BKF!; isotype BCU!).

Perennial, twining herb, with latex. *Rootstock* a cluster of fusiform, succulent, light brown roots, 7.2–15 cm long, 0.3–0.5 cm in diameter. *Stem* usually solitary, arising from fusiform roots, terete, glabrous, usually unbranched, 1–2 m long, 1.1–2.5 mm in diameter, green when young, turning brown with age; internodes 5–18.7 cm long. *Leaves* opposite; petiole slender, adaxially grooved, 1.3–2.6 mm long, 1.5–2.3 mm in diameter; blade broadly ovate, membranous, 4–7.9 × 2.4–5 cm, base rounded to subcordate with 1–2 small colleters on adaxial surface, margin entire, apex

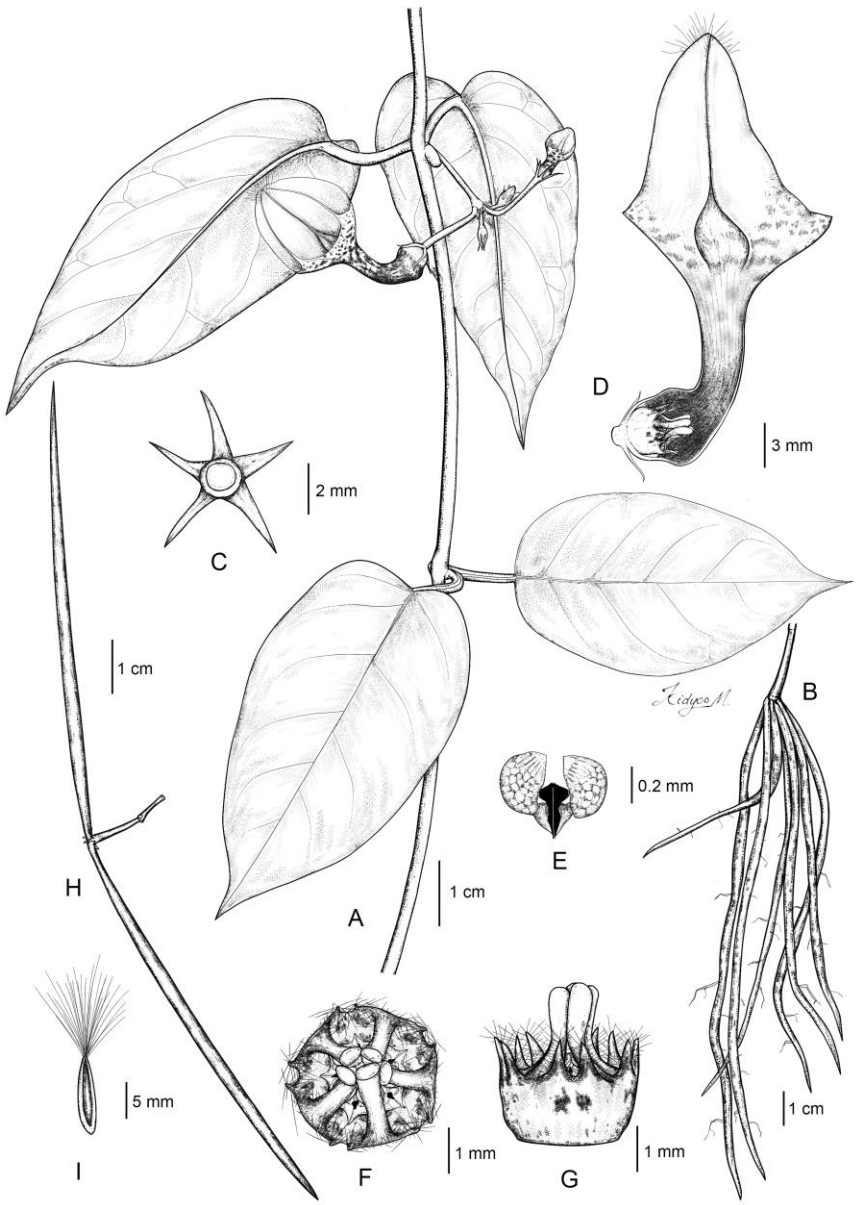

FIGURE 3. Illustration of *Ceropegia thorutii* Kidyoo. A. Flowering branch. B. A cluster of fusiform roots. C. Bottom view of calyx. D. Longitudinal section of flower showing corona and gynostegium. E. Pollinarium. F. Top view of gynostegium. G. Side view of gynostegium. H. Fruit. I. Seed. Photos by Manit Kidyoo from *M. Kidyoo 1552* (A-I) and *M. Kidyoo 1643* (J)

acuminate; abaxial surface pale green, adaxial surface green, glabrous on both surfaces; veins visible on both surfaces, 4–6 pairs. *Inflorescences* extra-axillary, 3–5-flowered cyme; peduncle slender, 1.2–2 cm long, 1–1.2 mm in diameter; pedicel green

FIGURE 4. *Ceropegia thorutii* Kidyoo. A. Habitat. B. Habit. C. Side view of flower. D. Top view of flower. Photos by Manit Kidyoo

or pinkish white, 9–12 mm long, 1–1.2 mm in diameter, glabrous; bracteoles subulate to lanceolate, 1–2 mm long, green to greenish brown, apex acuminate, glabrous. *Sepals* green or greenish brown, narrowly triangular, 3.2–3.5 × 0.7– 0.8 mm, sharply

acute at apex, glabrous. *Corolla* upright, strongly curved; corolla tube glabrous, green to yellowish green with reddish brown bands or dots, 1.9–2.2 cm long, glabrous, slightly inflated at base, 5–6 mm in diameter, then narrowing into a tube of 2.5–3.0 mm diameter and gradually widening upwards, mouth of the tube 1.2–1.4 cm in diameter; its interior glabrous, maroon or reddish brown; lobes ovate-triangular, glabrous, 1–1.1 × 0.9–1 cm, greenish white at proximal part and greenish or yellowish white at distal part, apex acute-obtuse with long purple trichomes at margin, apically connate and forming a subglobose cage-like structure, each lobe reduplicate from near the base. *Gynostegium* sessile. *Corona* double; outer (interstaminal) corona formed by 5 lobes, joined to form a shallow cup, 3.5–3.7 mm in diameter, apex of lobes deeply bifid, segments triangular-lanceolate, 1.1–1.2 mm long, apices acute, purple to dark purple and covered with white trichomes; inner (staminal) corona formed by 5 lobes, spathulate-clavate, 2.3–2.5 mm long, 0.4–0.5 mm in diameter, proximal part purple to reddish brown, incumbent upon dorsal surface of anthers, distal part connivent-erect, yellow, apex obtuse. *Pollinaria* 5; pollinium broadly ovoid, yellow, 0.34–0.37 × 0.24–0.26 mm, translator arms short, ca. 0.1 mm long, corpusculum spathulate, reddish brown, 0.30–0.35 × 0.18–0.19 mm. *Follicles* usually 2, linear-lanceolate in outline, 12.5–16 cm long, 0.3–0.4 cm in diameter, green when young but turning reddish brown with age. *Seeds* narrowly ovate, 9–10 × 2.2–2.8 mm, brown; coma 1–1.5 cm long, silky white.

Thailand.– NORTHERN: Chiang Mai [Fang district, Doi Ang Kang, 1600 m alt., 29 July 2012, *Kidyoo 1552* (**BCU**, **BKF**), *Kidyoo 1643* (**BCU**)].

Ecology and distribution.– *Ceropegia thorutii* is endemic to Thailand, occurring on limestone rock in shady areas within highland limestone forest at 1,500–1,600 m alt. It grows inside rock cracks or rock pools where humus soil has collected or in calcareous soil intermingled with other herbs and small shrubs. Its stem and branches usually climb upon small shrubs and cliffs, or branches can be pendent. Flowering occurs in July–October.

Etymology.– The specific epithet, '*thorutii*' was designated in honor of Mr. Chanin Thorut who first discovered and drew my attention to this plant.

Conservation Status.– *Ceropegia thorutii* is apparently rare, being known from a single degraded locality in Doi Ang Kang. This site has suffered from severe destruction by human exploitation. Land cover has been altered by villagers to produce agricultural crops (Fig. 5). Over a 10-year period, the number of plants has been drastically reduced. Following the IUCN Red List Categories and Criteria (2017), this species should be treated as critically endangered species (CR).

Notes.– *Ceropegia thorutii* possesses essential morphological features corresponding to those of the section *Janthina* H.Huber (sensu Bruyns et al., 2017). This section includes about 11 species, distributed from India, Sri Lanka, Malaysia, Philippines to northern Australia (Huber, 1957; Bruyns et al., 2017; Kambale et al., 2019). Comparison between the new species and all members of the section indicated that it is most similar to *C. elegans*, a species from India and Sri Lanka. Both species are slender climbers with fusiform roots, twining glabrous stems, glabrous and membranous ovate leaves, pedunculate cymes, a strongly curved funnel-shaped corolla tube with a basal inflated portion topped by a dome-shaped

FIGURE 5. The degraded habitats of *Ceropegia thorutii* Kidyoo. A. Field and orchard at mountain foot. B. Degraded habitat nearly the top of mountain. C. An unhealthy plant growing on limestone rock (red arrow) in orchard. Photos by Manit Kidyoo

structure formed by broadly ovate corolla lobes that are shorter than corolla tube and joined apically. Prominently, the distal margins of these corolla lobes are covered with long trichomes. However, detailed examination of floral characteristics revealed

that *C. thorutii* is clearly distinguished from *C. elegans* in having a corolla tube that is slightly dilated at base and glabrous throughout on its inner surface, and bifid interstaminal corona lobes with triangular-lanceolate segments. On the contrary, *C. elegans* has a corolla tube being strongly dilated at base with a ring of trichomes on the inner surface of its mouth. Its interstaminal corona lobes are deeply bifid with linear segments nearly as long as staminal corona lobes (Kambale and Yadav, 2019; Pullaiah et al., 2019).

ACKNOWLEDGEMENTS

I am deeply grateful to Assoc. Prof. Dr. Obchant Thaithong for her support and valuable comments on this manuscript. I thank the staff of the herbaria BK, BKF, BM, K, L, QBG, and P for permission to study herbarium specimens. This study is supported by the Rachadaphiseksomphot Endowment Fund 2020 of Chulalongkorn University (CU_63_62_23_06).

LITERATURE CITED

Bruyns, P.V., Klak, C. and Hanáček, P. 2015. Recent radiation of *Brachystelma* and *Ceropegia* (Apocynaceae) across the Old World against a background of climatic change. Molecular Phylogentics and Evolution 90: 49–66.

Brown, R. 1822. *Brachystelma tuberosum*. Curtis' Botanical Magazine 49: t. 2343.

Bruyns, P.V., Klak, C. and Hanáček, P. 2017. A revised, phylogenetically-based concept of *Ceropegia* (Apocynaceae). South African Journal of Botany 112: 399–436.

Endress, M.E., Meve, U., Middleton, D.J. and Liede-Schumann, S. 2018. Apocynaceae. In: Kadereit, J.W. and Bittrich, V. (Eds.). The Families and Genera of Vascular Plants 15. Cham: Springer International Publishing. pp. 207–411.

Huber, H. 1957. Revision der Gattung *Ceropegia*. Memórias da Sociedade Broteriana 12: 1–203.

IUCN. 2017. Standards and Petitions Subcommittee. Guidelines for Using the IUCN Red List Categories and Criteria. Version 13. Prepared by the Standards and Petitions Sub-Committee. http://www.iucnredlist.org/documents/RedListGuidelines.pdf [accessed 25.02.2018]

Kambale, S.S. and Yadav, S.R. 2019. Taxonomic revision of *Ceropegia* (Apocynaceae: Ceropegieae) in India. Rheedea 29(1): 1–115.

Li, P.T., Gilbert, M.G. and Stevens, W.D. 1995. Asclepiadaceae. In: Wu, Z.Y. and Raven, P.H. (Eds). Flora of China, Vol. 63. Science Press, Beijing & Missouri Botanical Garden, St. Louis 16: 189–270.

Linnaeus, C. 1753. Species Plantarum 1. Laurentii Salvii, Stockholm, 560 pp.

Murugesan, M., Mao, A.A. Meitei, L.R. and Kambale, S.S. 2019. *Ceropegia khasiana* (Apocynaceae: Ceropegieae), a new species from Meghalaya, Northeast India. Gardens Bulletin Singapore 71(2): 519–525.

Meve, U. 2002. *Ceropegia* L. In: Albers, F. & Meve, U. (Eds.). Illustrated handbook of succulent plants: Asclepiadaceae. Springer, pp. 63–108.

Pullaiah, T., Karuppusamy, S. and Rama Murthy, K.S. 2019. Monograph on *Brachystelma* and *Ceropegia* in India. CRC press, Taylor & Francis Group, Boca Raton.

Suwannakote, K. and Kidyoo, M. 2020. *Ceropegia graminea* (Apocynaceae: Asclepiadoideae), a new species from eastern Thailand. Kew Bulletin 75. https:// doi.org/10.1007/S12225-020-9869-3.

Thaithong, O., Kidyoo, A. and Kidyoo, M. 2018. Handbook of Asclepiads of Thailand. Amarin Printing and Publishing Public Company Limited, Bangkok, 326 pp.