

A revision of *Microchirita* (Gesneriaceae) in Thailand

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ABSTRACT. *Microchirita* (C.B.Clarke) Yin Z.Wang (Gesneriaceae: Didymocarpoideae) in Thailand is revised and 29 species are recognised, two of which have three varieties each. Eight new species are described, *Microchirita albocyanea* C.Puglisi, *Microchirita glandulosa* C.Puglisi, *Microchirita hypocrateriformis* C.Puglisi, *Microchirita limbata* C.Puglisi, *Microchirita luteola* C.Puglisi, *Microchirita tadphoensis* C.Puglisi, *Microchirita tatsanae* C.Puglisi, *Microchirita thailandica* C.Puglisi; three new varieties are described, *Microchirita involucrata* var. *gigantiflora* C.Puglisi, *Microchirita mollissima* var. *glabra* C.Puglisi, *Microchirita mollissima* var. *glandulophylla* C.Puglisi; and one name is combined at a new rank, *Microchirita involucrata* var. *capitis* (Craib) C.Puglisi. Two lectotypifications are made, one of which is a second step lectotypification. A key to all taxa is given, all taxa are described, and many are illustrated.

Keywords. *Chirita*, Didymocarpoideae, *Flora of Thailand*, Gesneriads, new species, taxonomy

Introduction

Generic delimitation in Asian Gesneriaceae has been the focus of much recent research and has led to considerable change (Wei et al., 2010; Möller et al., 2011, 2014, 2016; Puglisi et al., 2011, 2016; Wang et al., 2011; Weber et al., 2011a, 2011b; Middleton & Möller, 2012; Middleton et al., 2014, 2015). This research, much of it based on the results of DNA sequence data, has resulted in an overall reduction in the number of genera but also the description of new genera to accommodate new species which were found to belong to previously unknown lineages (Middleton & Triboun, 2012; Middleton et al., 2015), and the splitting up of genera found to be polyphyletic (Weber et al. 2011a; Möller et al., 2014). Although there are still many questions to address, a relative degree of stability in the delimitation of Asian Gesneriaceae genera has been reached.

The genus *Chirita* Buch.-Ham. is one of the genera that was split up as a consequence of molecular phylogenetic research which found the genus to be polyphyletic (Wang et al., 2011; Weber, 2011a). *Chirita* was characterised by the presence of a “chiritoid” stigma (a two-lipped stigma with the upper lip reduced and the lower bilobed) but was otherwise extremely morphologically diverse. The genera into

which it has been divided are *Damrongia* Kerr ex Craib, *Henckelia* Spreng. (including *Chirita* itself), *Liebigia* Endl., *Microchirita* (C.B.Clarke) Yin Z.Wang and *Primulina* Hance (Weber et al. 2011a). Each of these genera is much more morphologically coherent than was *Chirita*. *Primulina* continues to grow in the number of species and is in need of revision, *Liebigia* has been revised as a section of *Chirita* (Hilliard, 2004), *Damrongia* has been revised for Thailand, its centre of diversity (Puglisi & Middleton, 2017), *Henckelia* is being investigated by a number of research groups (Möller, pers. comm.; Sirimongkol, pers. comm.), and *Microchirita* is the subject of this paper.

Microchirita is found in India, Myanmar, southern China, Thailand, Vietnam, Laos, Cambodia, Peninsular Malaysia, Sumatra, Java and Borneo, almost exclusively in limestone habitats. As part of his revision of *Chirita*, Wood (1974) included 18 species in *Chirita* sect. *Microchirita* C.B.Clarke. Of these, *Chirita elata* Ridl. has since been removed to the genus *Codonoboea* Ridl. (Rafidah et al., 2011) and eleven additional species have been described (Punekar & Lakshminarasimhan, 2009; Middleton & Triboun, 2013; Rafidah & Haron, 2013; Puglisi et al., 2016). This brings the total to 28 species of which 22 have been recorded for Thailand (Wood, 1974; Burt, 2001; Middleton & Triboun, 2013; Puglisi et al., 2016), one mistakenly (*Chirita caerulea* R.Br. by Wood, 1974), leaving 21 species. This clearly makes Thailand the centre of diversity of the genus with $\frac{3}{4}$ of the known species in the genus found there. The lectotype of the genus is *Microchirita hamosa* (R.Br.) Yin Z.Wang.

The most characteristic morphological feature of many species of *Microchirita* is the cristate inflorescence consisting of a single row of flower pairs (Fig. 1A). The young flowers develop against the base of the lamina. Subsequently the pedicels straighten to an upright position when the flowers reach maturity, and bend backwards towards the main stem at the fruiting stage. The series of flower pairs appears as a crest along the petiole, and often there is tissue melding together the peduncles at the base. Wood (1974) interpreted this crest as a single inflorescence whose peduncle is fused with the petiole. Weber (1975) instead supported the idea of a system of multiple inflorescences generated by an enlarged meristem which is displaced from the axil onto the petiole. No attempt was made to characterise the inflorescence in this study, and for merely practical reasons we have chosen to refer to a “cristate inflorescence” when applicable, without implying the acceptance of Wood’s theory over Weber’s. Some species (e.g. *Microchirita involucrata* (Craib) Yin Z.Wang) have inflorescences which do not appear cristate. They consist of one or few well-developed peduncles arising from the axillary end of the petiole, each topped by paired bracts (free or fused), and culminating in a subumbellate cluster of pedicels (Fig. 1B).

The species of *Microchirita* are annual or short-lived. The stems are often fleshy and green, tinged with purple-brown. Another characteristic feature of *Microchirita* is the leaf arrangement: the basal leaf, the macrocotyledon, is single, although sometimes the paired leaf, the much reduced microcotyledon, persists. The subsequent leaves are opposite. This general structure may not be apparent in *Microchirita mollissima* (Ridl.) A.Weber & D.J.Middleton and most Malaysian species (Rafidah, 2017). In these the internodes are shorter and the leaves more crowded, thereby obscuring the phyllotaxis. Also, the inflorescences develop at the axillary end and are less dense. Some species



Fig. 1. Inflorescence types. **A.** Cristate inflorescence of *Microchirita bimaculata* (D.Wood) A.Weber & D.J.Middleton. From Middleton, D.J. *et al* 4514. **B.** Bracteate inflorescence of *Microchirita rupestris* (Ridl.) A.Weber & Rafidah. From Puglisi, C. *et al.* CP409. (Photos: A, D.J. Middleton; B, P. Karaket)

may flower when only the macrocotyledon has developed and can be mistakenly interpreted as unifoliate, a common state in *Microchirita hamosa* for example. Generally this is very variable, even within a single population, with a mixture of plants flowering at different sizes and stages of development. The macrocotyledon can be much larger than the paired leaves, leading to broad ranges of leaf size and number of secondary veins.

Much variation can be observed in the corolla of *Microchirita*. The tube is generally narrow at the base, often bent downwards, and widens more or less abruptly, into a campanulate, funnel-shaped or tubular upper corolla. The colour of the corolla varies substantially from pure white to a lilac-purple-blue palette, or to a pale yellow-yellow-dark orange range. The colour is rarely uniform throughout the corolla. Some species (e.g. *Microchirita albocyanea* C.Puglisi) have lobes of a different shade from the tube; most species (e.g. *M. tubulosa* (Craib) A.Weber & D.J.Middleton) have a ventral yellow line running from the base of the ventral lobe to the throat; many species (e.g. *M. bimaculata* (D.Wood) A.Weber & D.J.Middleton) have lines or spots either at the base of the lateral lobes or at the base of the upper lip; finally, in few taxa (e.g. *M. rupestris* (Ridl.) A.Weber & Rafidah), the venation of the petals is visible in the form of fine purple lines running along the lobes and anastomosing terminally. The colour and patterning of the corolla are taxonomically significant. Some species appear to have a purple/blue form and a white equivalent (e.g. *M. hypocrateriformis* C.Puglisi). Where this variation was not substantiated by allopatry or further morphological differentiation, no taxonomic distinction is made.

Anthers of *Microchirita* species can be free, coherent face-to-face, or apically joined by a ligament. Furthermore, anthers can be glabrous or bear an indumentum, especially dorsally at the filament insertion. The indumentum is usually of long, somewhat woolly, eglandular hairs, but in some species additional, shorter and straight hairs are seen.

In this account, *Microchirita* in Thailand is revised and 29 species, two of which have three varieties each, are recognised. Of these, eight species and three varieties are newly described.

Material and methods

This revision is based on a study of the specimens from the herbaria A, AAU, ABD, BK, BKF, BM, CMU, CMUB, E, K, KEP, L, P, PSU, QBG, SING, US (Thiers et al., 2017, continuously updated), and Mahidol University, Kanchanaburi Campus (MUKA). All specimens have been seen unless otherwise noted. Measurements of all but the floral parts were taken from dry specimens. Flower measurements are from rehydrated or pickled flowers. When no additional material of the recently published species (Middleton & Triboun, 2013; Puglisi et al., 2016) was obtained, we give measurements from the original descriptions. Measurements of the flowers were taken with a microruler and should be considered accurate to 0.05 mm.

Conservation assessments follow the guidelines laid out in IUCN (2012).

The authors have seen more than half of the species in this revision in the field. Field characters have been instrumental in gaining a better understanding of the species to aid in species delimitation. In particular it becomes quite obvious in the field that plants flowering as early as the macrocotyledon stage are completely mixed into populations of much larger plants and that previous taxonomic distinctions based on plant size are untenable. We have not seen living plants of some of the species in the Northeast of Thailand but have been greatly aided by photographs taken by collectors. Many species of *Microchirita* are rather similar when pressed and dried and we urge collectors to ensure good collection notes, especially in corolla colour and colour variation characters, and to take photographs of the living plants. The species are presented in alphabetical order.

Taxonomic treatment

Microchirita (C.B.Clarke) Yin Z.Wang, J. Syst. Evol. 49: 59 (2011). – *Chirita* sect. *Microchirita* C.B.Clarke in Candolle & Candolle, Monogr. Phan. 5: 127 (1883). – *Roettlera* sect. *Microchirita* (C.B.Clarke) Fritsch in Engler & Prantl, Nat. Pflanzenfam. IV/3b: 148 (1895). – *Didymocarpus* sect. *Microchirita* (C.B.Clarke) Chun, Sunyatsenia 6: 290 (1946). – TYPE: *Microchirita hamosa* (R.Br.) Yin Z.Wang, lectotype designated by Burtt (1954: 196).

Annual or semiperennial herbs, often with succulent stems. **First leaf** (macrocotyledon) often persistent and single (not paired), second cotyledon rudimentary or suppressed; all other leaves in opposite pairs, sessile or petiolate. **Inflorescences** axillary or epiphyllous, often crested (see Introduction above); peduncles normally developed in axillary inflorescences, reduced and sometimes fused with each other in crested inflorescences; bracts present in axillary inflorescences, divided or somewhat fused; flowers 5-merous. **Calyx** lobes divided almost to base or short tube present. **Corolla** of a narrow lower tube, a wider upper tube and a bilabiate limb, upper lip 2-lobed, lower lip 3-lobed, variable in shape and colour. **Stamens** 2, filaments straight or bent, anthers often densely hairy and joined by a ligature; staminodes 3. **Disk** present, often annular, occasionally partial, or absent. **Ovary** unilocular with parietal placentation, mostly fusiform; style distinct; stigma chiritoid (see Introduction above); ovules many. **Fruit** a narrow, bivalved capsule. Seeds many.

Key to *Microchirita* species in Thailand

- | | | |
|-----|---|---|
| 1a. | Inflorescence with distinct bracts in inflorescence, bracts free or fused together .. | 2 |
| 1b. | Inflorescence without distinct bracts in inflorescence | 6 |
| 2a. | Glandular hairs present on pedicels and/or peduncles | 3 |
| 2b. | Glandular hairs not present on pedicels and/or peduncles | 4 |

- 3a. Bracts fused at the base; leaves with dense short glandular hairs and long eglandular hairs 6. *M. glandulosa*
- 3b. Bracts free; leaves with only eglandular indumentum 11. *M. involucrata*

- 4a. Corolla 32–45 mm long, lobes orange 16. *M. marcanii*
- 4b. Corolla 16.5–33 mm long, lobes white to purple or blue 5

- 5a. Leaves sessile to shortly petiolate, ≤ 2.5 cm long; leaf blades 2.2–7.2 times as long as wide, with a silvery white “soft” indumentum; stems with indistinct internodes 18. *M. mollissima*
- 5b. Leaves with petioles 2–10 cm long; leaf blades 1.5–2.7 times as long as wide, with a hispid “rough” indumentum; stems with well-defined internodes 22. *M. rupestris*

- 6a. Glandular hairs present on pedicels and/or peduncles in addition to any eglandular indumentum 7
- 6b. Glandular hairs not present on pedicels and/or peduncles in addition to any eglandular indumentum 10

- 7a. Corolla lobes pale yellow; calyx lobes 14–17 mm long 15. *M. luteola*
- 7b. Corolla lobes blue or purple; calyx lobes 4.5–15 mm long 8

- 8a. Corolla with two spots inside the lateral lobes; calyx lobes 13–15 mm long 3. *M. aratriliformis*
- 8b. Corolla without spots inside the lateral lobes; calyx lobes 4.5–8.5 mm long 9

- 9a. Corolla tubular, widening abruptly; upper lobes dark purple at base 26. *M. thailandica*
- 9b. Corolla with a narrow lower tube which broadens into a campanulate upper tube; upper lobes without a dark patch 14. *M. limbata*

- 10a. Anthers glabrous 11
- 10b. Anthers hairy 15

- 11a. Corolla ≥ 18 mm long, with a patch of elongated glands internally between the upper lobes 18. *M. mollissima*
- 11b. Corolla ≤ 15 mm long, without a patch of elongated glands between the upper lobes (but sometimes with shorter and more evenly distributed glands on the upper lobes) 12

- 12a. Corolla with a broadly campanulate upper tube, lobes very pale lilac 13. *M. lilacina*
- 12b. Corolla with an upper tube which is not campanulate, lobes (at least the lower) pure white 13

- 13a. Corolla personate, upper lip greenish white and much smaller than lower lip 20. *M. personata*
- 13b. Corolla not personate, upper lip pure white and of similar size to lower lip 14
- 14a. Corolla curved downwards and trumpet-shaped; fruit 2–5 cm long, sparsely hairy 1. *M. albiflora*
- 14b. Corolla not curved downwards and tubular; fruit 1.2–2 cm long, densely hairy 7. *M. hamosa*
- 15a. Corolla with obvious dark markings either at the base of the lateral lobes, at the base of the upper lobes, or deeper inside the throat 16
- 15b. Corolla without obvious dark marking and fairly uniform in colour 27
- 16a. Calyx with glandular hairs outside 9. *M. huppatatensis*
- 16b. Calyx without glandular hairs outside 17
- 17a. Corolla lobes lilac, violet, purple or blue 18
- 17b. Corolla lobes white, yellow or orange 20
- 18a. Elongated glands present inside sinus of upper corolla lobes; anthers coherent but not apically joined by a connective [Peninsular Thailand] 28. *M. viola*
- 18b. Elongated glands absent inside sinus of upper corolla lobes; anthers apically joined by a connective [SE, N and NE Thailand] 19
- 19a. Corolla tube gradually flaring, not abruptly widening, lobes spreading, predominantly whitish, pale yellow or blue [N & NE Thailand] ... 25. *M. tetsanae*
- 19b. Corolla tube of a distinct narrow lower tube and abruptly widening into a campanulate upper tube, lobes not spreading, predominantly dark purple [Chanthaburi] 21. *M. purpurea*
- 20a. Corolla bright yellow with an obvious dark ring inside the throat 19. *M. oculata*
- 20b. Corolla lobes white, yellow or orange without a dark ring in throat 21
- 21a. Corolla 32–45 mm long, lobes orange 16. *M. marcanii*
- 21b. Corolla 12–30 mm long, lobes white or pale to bright yellow 22
- 22a. Corolla lobes predominantly bright yellow 23
- 22b. Corolla lobes predominantly white to very pale yellow or cream 24
- 23a. Ventral corolla lobe 8–10 × 6.5–10 mm; filaments geniculate or twisted so as to appear divided into two halves 5. *M. elphinstonia*
- 23b. Ventral corolla lobe 2.3–5.2 × 2.5–7.5 mm; filaments straight and uniform 4. *M. bimaculata*

- 24a. Corolla with dark spots at the base of the upper lobes 25. *M. tetsanae*
 24b. Corolla with dark spots at the base of the lateral lobes 25
- 25a. Corolla ventral lobe < 5 mm long, overall corolla length 12–18 mm long, lobes white 12. *M. karaketii*
 25b. Corolla ventral lobe \geq 5 mm long, overall corolla length 17–25 mm long, lobes white or yellow-white 26
- 26a. Corolla with yellow-white lobes and yellowish throat in addition to the ventral yellow line and lateral markings; anthers with a strongly dimorphic indumentum 29. *M. woodii*
 26b. Corolla with pure white lobes and white in throat in addition to the ventral yellow line and lateral markings; anthers with only one type of hairs 27. *M. tubulosa*
- 27a. Anther indumentum of two distinct hair types 28
 27b. Anther indumentum of a single hair type 30
- 28a. Filaments glabrous 2. *M. albocyanea*
 28b. Filaments eglandular hairy 29
- 29a. Calyx $7.5\text{--}13 \times 1.2\text{--}1.7$ mm, apex acute; corolla yellow 17. *M. micromusa*
 29b. Calyx $4.5\text{--}8 \times 1\text{--}1.2$ mm, apex acuminate; corolla white or purple-blue 25. *M. tetsanae*
- 30a. Corolla pale yellow 24. *M. tadphoensis*
 30b. Corolla white, lilac, purple or blue 31
- 31a. Corolla with a ventral yellow or orange stripe 32
 31b. Corolla without a yellow ventral stripe 33
- 32a. Corolla with a narrow tube abruptly opening up into spreading lobes, corolla white or blue, with a fringe of glandular hairs at the base of the upper lobes [Chaiyaphum, Loei] 10. *M. hypocrateriformis*
 32b. Corolla broadly campanulate, white to pale lilac except at very base of tube, with short stalked glands not forming an obvious fringe [Kanchanaburi] 8. *M. hemratii*
- 33a. Corolla 18–33 mm long; leaves softly tomentose [Peninsular Thailand] 18. *M. mollissima*
 33b. Corolla 10–13 mm long; leaves sparsely eglandular hairy [Northern Thailand] 23. *M. suddeeii*

1. *Microchirita albiflora* D.J.Middleton & Triboun, Thai Forest Bull., Bot. 41: 19 (2013). – TYPE: Thailand, Chiang Rai, Mae Fa Luang District, Road to Doi Tung Royal Residence, 1000 m alt., 23 September 2008, *Middleton, D.J., Karaket, P., Triboun, P., Kawatkul, U. & Meeboonya, R.* 4567 (holotype BKF; isotypes BK, E [E00629491], K, P [P00966762], QBG, SING [SING0229831]). (Fig. 2A–C)

Caulescent herb to 50 cm tall, with internodes to c. 10 cm, unbranched. **Stems** fleshy, glabrescent or with very sparse short eglandular hairs, pale green or sometimes purple-brown at the base. **Leaves** opposite, except for the basal leaf; petioles 0.2–1.7 cm long, basal leaf often sessile, glabrescent; blades mid-green above, pale green beneath, ovate, $2.6\text{--}23 \times 1.7\text{--}11$ cm, 1.5–2.2 times as long as wide, base cordate, apex acute to shortly acuminate, eglandular tomentose above, hispid beneath, margin entire, 7–12 pairs of secondary veins, tertiary venation laxly reticulate. **Inflorescences** cristate, peduncles reduced or emerging to 1–3 mm long, fused with each other, glabrous, bracts absent; pedicels 5–10 mm long, glabrescent or sparsely eglandular hairy. **Calyx** green, bilabiate; tube 0.5–3.7 mm dorsally, c. 0.2 mm ventrally, lobes narrowly lanceolate to ligulate, upper lobes 5–7.8 mm long, lower lobes $4\text{--}7.8 \times 0.5\text{--}1.2$ mm, sparsely eglandular pubescent especially on midrib and tip, glabrous inside, apex acuminate. **Corolla** 7–15 mm long, white, sometimes with a ventral yellow line, tube curved downwards, trumpet-shaped, lobes not spreading, outside glabrous basally, eglandular tomentose above, inside glabrous, with a glandular patch below the upper lobes; tube 6.5–13 mm long, equal dorsally, laterally and ventrally; lobes broadly orbicular, upper lobes $1.6\text{--}1.9 \times 2.2\text{--}3.1$ mm, lateral lobes $1.6\text{--}2.7 \times 2\text{--}3$ mm, lower lobe $1.4\text{--}2 \times 2.6$ mm. **Stamens** arising 2.7–4.7 mm above the corolla base, filaments straight, minutely glandular (glabrous in protologue), 2.1–3.1 mm long, 0.2–0.5 mm wide; anthers glabrous, $0.6\text{--}1.1 \times 1\text{--}2$ mm, free or coherent by a weak ligature, thecae divergent; lateral staminodes c. 0.6 mm long, arising near the corolla base, central staminode c. 0.4 mm long, arising near the corolla base. **Disk** partial, ventral, lobed, 0.3–0.7 mm. **Pistil** c. 12 mm long; ovary 4.7–6 mm long, c. 0.6 mm diameter, glabrous or papillose in lower 2/3, densely pubescent in upper 1/3, many ovules; style c. 4 mm long, densely pubescent; stigma deeply bilobed, 0.7–1 mm long. **Fruit** green, 2–5 cm long, 1–1.7 mm diameter, with sessile glands at base, then becoming sparsely eglandular hairy, curved. **Seeds** dark brown, elliptic, $0.6\text{--}0.7 \times 0.3\text{--}0.4$ mm.

Distribution. Northern Thailand. India, (Myanmar?), Laos.

Habitat. On rocks in mixed forest.

Provisional IUCN conservation assessment. Near Threatened NT. In Middleton & Triboun (2013) this species was given a conservation status of Endangered. Since then specimens have also been identified from NE India and Myanmar. From the known localities, the AOO is still within the threshold for an Endangered assessment but large swathes of territory within the large EOO, particularly in Myanmar, have not been adequately explored to base an assessment on this. As limestone areas throughout the

region are threatened by mining and tourism an updated assessment of Near Threatened is appropriate.

Additional specimens examined. THAILAND: **Chiang Mai:** Mae Taeng, Sop Berng, Mawk Fa Falls, 650 m, 18 Aug 1990, *Maxwell, J.F.* 90-887 (A, CMU, L). **Chiang Rai:** Mae Fa Luang, along main road, 500 m N of Phratamnak, Doi Tung Development Project offices, 23 Sep 2010, *van de Bult, M.* 1076 (BKF); Mae Sai, Wat Tham Pha Jom, 500 m, 24 Sep 2008, *Middleton, D.J. et al.* 4577 (BKF, E, P, QBG, SING); Mae Sai, Pong Ngam, Ban Tham, Tham Pla, 400 m, 28 Oct 2005, *Maxwell, J.F.* 05-607 (A, BKF, CMUB); Mae Sai, Pong Ngam, San Pa Sak, Wat Tham Boom, 525 m, 7 Sep 2006, *Maxwell, J.F.* 06-646 (A, CMUB, QBG); Mae Sai, Pong Ngam, Wat Tham Phum, 410 m, 2 Nov 2010, *Norsaengsri, M. & Tathana, N.* 7228 (BKF, QBG); Mae Sai, Tahm Ban Santisuk, 550 m, 23 Sep 1989, *Maxwell, J.F.* 89-1120 (A, CMU, E).

Notes. This northern Thai species is recognisable by the white corolla and the glabrous anthers. It is most easily confused with *Microchirita hamosa*, from which it differs in the longer and more markedly broadened upper portion of the corolla (shorter and tubular in *M. hamosa*), and in the much longer and narrower capsule, which is also very sparsely hairy (densely hairy in *M. hamosa*). It differs from *Microchirita suddee* D.J.Middleton & Triboun in the glabrous anthers and in being pure white (not pale lilac). The floral measurements reported were largely extracted from Middleton & Triboun (2013) as not much new material was available for dissection.

2. *Microchirita albocyanea* C.Puglisi, **sp. nov.**

Most similar to *Microchirita limbata* C.Puglisi in the overall shape of the corolla and in colour, but differs in not having a glandular indumentum and in the much longer corolla and larger calyx. – TYPE: Thailand, Loei, Pha Khao, Wat Phu Phang, 447 m, 5 November 2014, *Tetsana, N. et al.* 876 (holotype BKF; isotype SING). (Fig. 2D–F)

Caulescent herb to 30 cm tall, internodes 3–5 cm. **Stem** succulent, sparsely eglandular hairy; not branching. **Leaves** opposite, apart from the basal leaf; petioles 0.1–1 cm long, sparsely eglandular hairy; blades mid green above, paler beneath, ovate to elliptic, 3.5–14.2 × 1.5–8 cm, 1.5–3 times as long as wide, base shortly attenuate to obtuse, apex acute to acuminate, eglandular pubescent above and beneath, margin finely serrulate, 4–13 pairs of secondary veins, venation sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation seldom visible in dry specimens. **Inflorescences** cristate, 2–15-flowered; peduncles reduced and shortly fused with each other, eglandular pubescent; bracts absent; pedicels pale green, 1–18 mm long, eglandular pubescent. **Calyx** greenish white, succulent at the base, tube c. 0.5 mm long, lobes narrowly lanceolate, c. 10–14 × 1.6–2.5 mm, apex acuminate and thickened, margin entire, with eglandular hairs outside especially along the midrib and the margin, glabrous inside. **Corolla** 21–25 mm long, tube white, throat white with a yellow patch at the base of the filaments, lobes purple-blue, tube narrow at the base, then becoming wider, not curved or only slightly so, lobes almost equal, glabrous at the base, then becoming progressively hairier, eglandular hairy outside, glabrous inside;

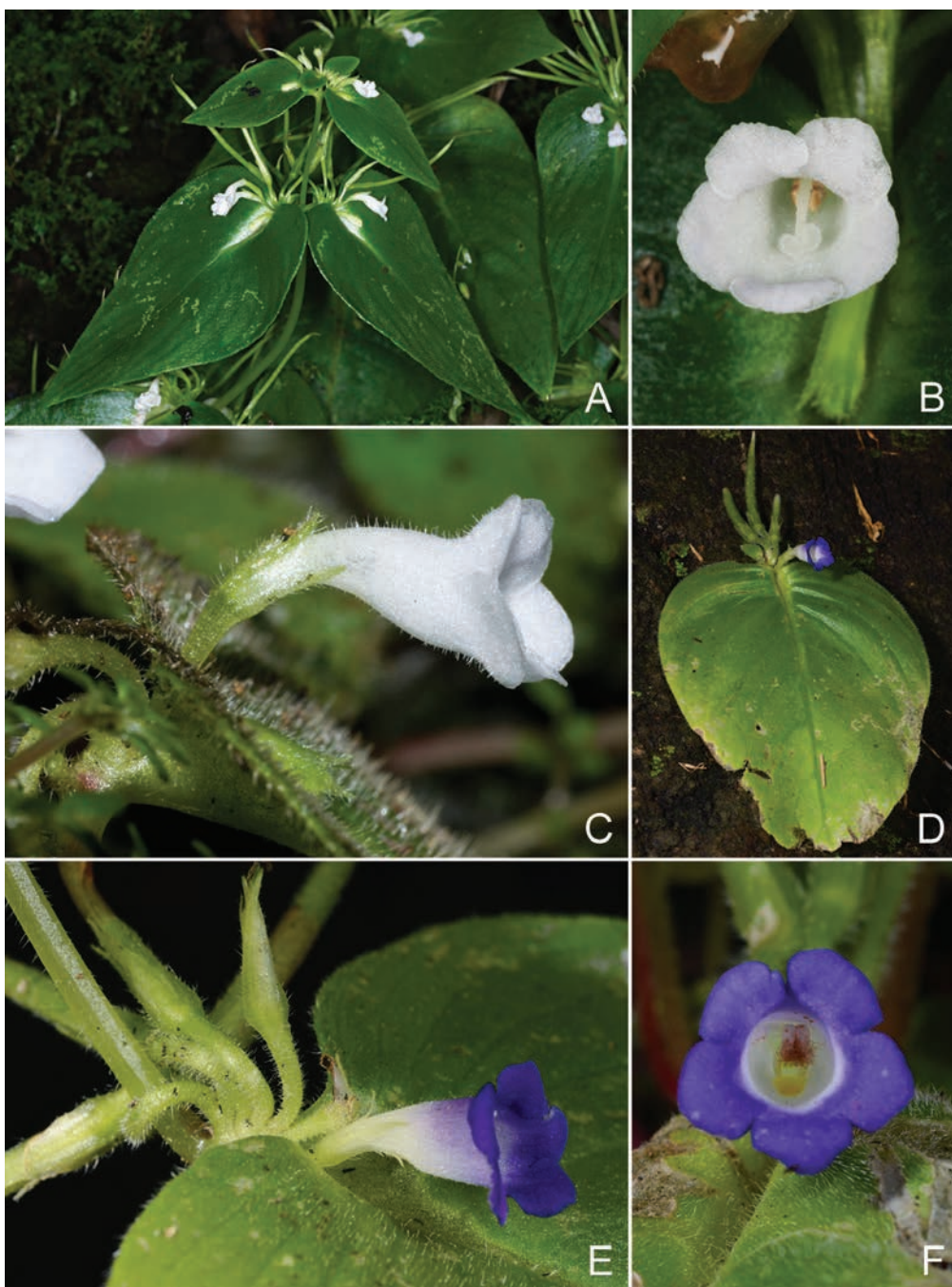


Fig. 2. *Microchirita albiflora* D.J.Middleton & Triboun. **A.** Habit. **B.** Front view of flower. **C.** Side view of the flower. All from Middleton, D.J. *et al.* 4567. *Microchirita albocyanea* C.Puglisi. **D.** Habit. **E.** Side view of the flower. **F.** Front view of the flower. All from Tetsana, N. *et al.* 876. (Photos: A, B, P. Karaket; C, D.J. Middleton; D–F, N. Tetsana)

tube 17–19 mm long dorsally, 18–22 mm ventrally, 16–20 mm laterally between lips; lobes elliptic, upper lobes $2.5\text{--}3.7 \times 5\text{--}6.5$ mm, lateral lobes $4.5\text{--}5 \times 5\text{--}7.5$ mm, ventral lobe $4.5\text{--}5 \times 4.5\text{--}7$ mm. **Stamens** arising 8.5–9 mm above the corolla base; filaments geniculate, yellow, glabrous, 2–3 mm long, 0.5–0.6 mm wide; anthers white, with a woolly orange indumentum dorsally and at base, and short appressed orange hairs around the apex, c. $1.5\text{--}2 \times 3$ mm, apically coherent and joined by a short ligature, thecae divergent; lateral staminodes 1.5–3 mm long, arising 6–7 mm above the corolla base, central staminode 0.3–0.5 mm long, arising c. 6 mm above the corolla base. **Disk** annular, margin entire or cleft dorsally, 0.1–0.4 mm high. **Pistil** (immature) 15–17 mm long; ovary 8–9 mm long, 1.2–1.7 mm diameter, glabrous around the base, then densely eglandular hairy; style c. 4 mm long, eglandular hairy, more sparsely towards the stigma; stigma bilobed, lobes elliptic, $0.5\text{--}2 \times 0.5$ mm. **Fruit** green, 2.3–5 cm long, 1–1.7 mm diameter, eglandular hairy, straight or slightly curved. **Seeds** light brown, narrowly elliptic, tri-tetragonal, mucronate, $0.2\text{--}0.5 \times 0.1\text{--}0.5$ mm.

Distribution. Northeastern Thailand (Loei).

Habitat. On limestone, in shade.

Provisional IUCN conservation assessment. Critically Endangered CR B1ab(iii). Although only known from a single collection the plant was collected from a limestone outcrop which has a total potential area suitable for the growth of *Microchirita* species of around 14 km² and which is not in a protected area. There has been development within the limestone range and agricultural land encroaches right to the base of the outcrop with the potential for changes in microclimate.

Notes. The epithet refers to the colour of the corolla tube and lobes.

3. *Microchirita aratriliformis* (D.Wood) A.Weber & D.J.Middleton, *Taxon* 60: 778 (2011). – *Chirita aratriliformis* D.Wood, *Notes Roy. Bot. Gard. Edinburgh* 31: 367 (1972); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 197 (1974); Burt, *Thai Forest Bull., Bot.* 29: 87 (2001). – TYPE: [Vietnam], Tonkin, Langson, Khanmoi, *Eberhardt* 3332 (holotype P [P00602506]). (Fig. 3A–B)

Caulescent herb to 60 cm tall, branching, internodes to c. 7 cm. **Stem** green, slightly fleshy, with a mixed indumentum of glandular and eglandular hairs. **Leaves** opposite except for the basal leaf; petioles 0.5–3 cm long, eglandular hairy; blades green above, paler beneath, lanceolate to elliptic, $4.8\text{--}10\text{--}(13+) \times 2.5\text{--}10$ cm, 1.6–2.1 times as long as wide, base acute to shortly acute or subcordate, apex acute to acuminate, sparsely eglandular hispid above and beneath, margin entire, 8–14+ pairs of secondary veins (basal leaf not seen), tertiary venation not visible. **Inflorescences** cristate, 4–10-flowered; peduncles 1–17 mm long, fused with each other, eglandular hairy; bracts absent; pedicels 15–20(–31 reported in literature) mm long, glandular

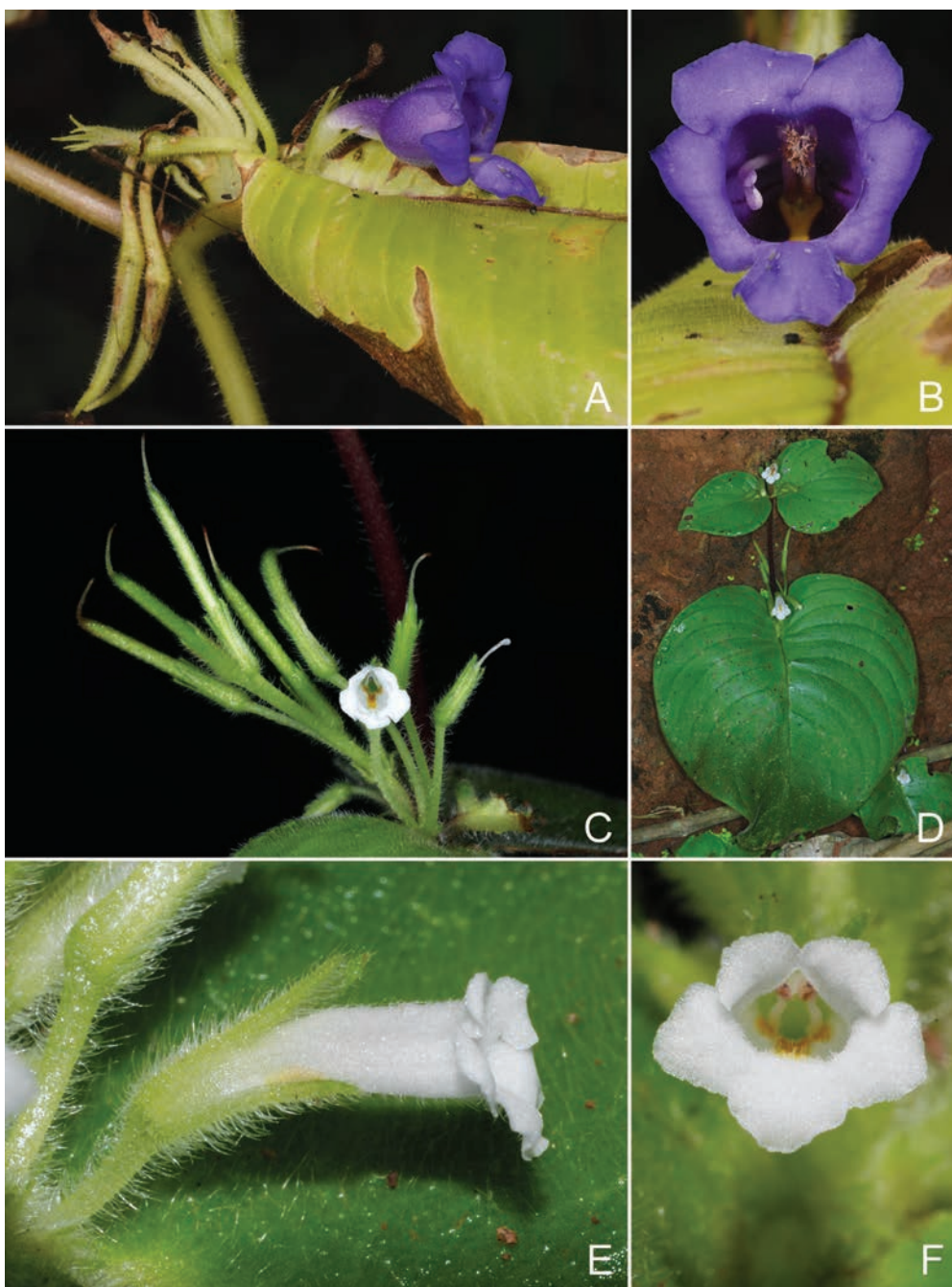


Fig. 3. *Microchirita aratririformis* (D.Wood) A.Weber & D.J.Middleton. **A.** Side view of the flower. **B.** Front view of flower. All from Tetsana, N. et al. 871. *Microchirita hamosa* (R.Br.) Yin Z.Wang. **C.** Cristate inflorescence and fruits. **D.** Habit. **E.** Side view of the flower. **F.** Front view of flower. C from Middleton, D.J. et al. 4519; D from Middleton, D.J. et al. 4522; E, F from Middleton, D.J. et al. 5016. (Photos: A, B, N. Tetsana; C, D, D.J. Middleton; E, F, P. Karaket)

and eglandular hairy. **Calyx** green, lobes divided almost to base, lanceolate, $13\text{--}15 \times 1.2\text{--}1.5$ mm, apex acuminate, glandular and eglandular hairy outside, especially along margins and midrib, glabrescent inside. **Corolla** c. 23(–28 reported in literature) mm long, white at base, turning purple above, lobes purple inside and outside, throat with a yellow ventral line and lateral dark patches, tube slightly curved, broadening into a pouched upper corolla, indumentum outside sparsely eglandular hairy, densely so by the lobes, inside glandular hairy. Stamens with hairy anthers. Disk not seen. Pistil enantiostylous, white to pale purple, ovary densely hairy. Fruit 2.1–9.5 cm long, 1.2–1.8 mm diameter, densely eglandular hairy, straight or slightly curved. Seeds brown, elliptic, $0.6\text{--}0.7 \times 0.2\text{--}0.3$ mm.

Distribution. Northeastern Thailand (Khon Kaen, Loei). Vietnam.

Habitat. On limestone rock in shade.

Provisional IUCN conservation assessment. Endangered EN B2ab(iii). This species is quite widespread but only known from rather few collections in Thailand and Vietnam. It is likely to also occur in Laos but the distribution is fragmented and the likelihood of the AAO being >500 km², even with new localities being discovered, is rather remote. Throughout the region limestone habitats are threatened with mining, tourism and land use changes. The assessment is not altered by changes in the status of the dubious specimens below.

Additional specimens examined. THAILAND: **Loei:** Nong Hin, Num Sow, Phu Pha Lorn Forest Park, 435 m, 5 Nov 2014, *Tetsana, N. et al.* 871 (BKF). **Khon Kaen:** Phuphaman NP, 300 m, 24 Aug 2011, *Norsaengsri, M. et al.* 8086 (QBG).

Dubious specimens. THAILAND: **Loei:** near Phu Kradung, Pha Nok Khao, 250–350 m, 6 Nov 1970, *Charoenphol, C. et al.* 4585 (AAU, E, L). **Khon Kaen:** Pha Nok Khao, 600–700 m, 9 Sep 1963, *Smitinand, T. et al.* 1129 (E, L).

Notes. *Microchirita aratriformis* is a poorly known species. The placement of any Thai specimens into it has to be considered tentative and based on the presence of axillary shoots, cristate inflorescence, pedicels with mixed indumentum types, ventral yellow line, and an approximate match of calyx and corolla size. The flowering material available for this study was extremely limited, therefore the only thorough description of the inner flower parts remains that of Wood (1972, 1974). The specimens cited as ‘dubious’ above are those placed in this species by Burt (2001) which are not good collections and we cannot be entirely sure they belong here.

4. *Microchirita bimaculata* (D.Wood) A.Weber & D.J.Middleton, *Taxon* 60: 778 (2011). – *Chirita bimaculata* D.Wood, *Notes Roy. Bot. Gard. Edinburgh* 31: 368 (1972); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 196 (1974); Burt, *Thai Forest*

Bull., Bot. 29: 87 (2001). – TYPE: Thailand, Maeklang Falls, c. 50 km Northwest of Chiang Mai, c. 430 m, 3 November 1967, *Burt*, *B.L. 5611* (holotype E [E00155280]). (Fig. 4)

Caulescent herb to 50 cm tall, internodes 2–10 cm. **Stems** succulent, green or brown, glabrous or glabrescent, unbranched. **Leaves** opposite, apart from the basal leaf; petioles 0.2–1.5(–2.5) cm long, eglandular hairy; blades mid green above, pale green beneath, lanceolate or ovate, 3.2–16.6(–30+) \times 1.4–9.5(–19) cm (measures in bracket refer to estimate measurements of incomplete basal leaves), 1.4–2.8 times as long as wide, base cordate, rounded or seemingly shortly attenuate, apex acuminate or acute, eglandular hairy above and beneath, not ciliate along the margin, margin entire, 8–15 pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation laxly reticulate. **Inflorescences** cristate, peduncles reduced or emerging to 15 mm long and fused together; bracts absent; pedicels green to reddish brown, 5–20 mm long, eglandular hairy. **Calyx** pale to mid green, regular, succulent at base, tube 0.3–1 mm, lobes narrowly lanceolate to elliptic, 5–10 \times 0.7–1.8 mm, apex acute, margin irregularly entire, occasionally toothed, hairy on midrib, margin and tip outside, glabrescent or glandular inside. **Corolla** c. 21 mm long, bright yellow with a reddish brown patch ventrally inside, sometimes split into two lateral patches, throat greenish yellow, narrow part of the tube curved, then widening, upper lobes spreading, base of tube glabrous, broader part sparsely eglandular hairy, lower lobes papillose, upper lobes and throat with scattered glandular hairs; tube 10.5–18 mm long dorsally, 12–19 mm ventrally, 10.5–15 mm laterally between lips; lobes elliptic, apices rounded, upper lobes 1–4 \times 2.5–5.1 mm, lateral lobes 2.5–5 \times 3.3–6 mm, ventral lobe 2.3–5.2 \times 2.5–7.5 mm. **Stamens** arising 5–11 mm above the corolla base; filaments straight, pale green, glabrous, 2–2.6 mm long, c. 0.2–0.6 mm wide; anthers hairy dorsally, 1.1–2 \times 0.6–1.1 mm, apically joined by a connective, thecae subparallel; lateral staminodes 0.6–1.5 mm long, arising 3–6.5 mm above the corolla base, central staminode 0.4–0.5 mm long, arising 7–8 mm above the corolla base. **Disk** annular or cleft dorsally, margin entire, 0.2–0.9 mm high. **Pistil** 11.5–15 mm long; ovary 2–6 mm long, papillose at the base, apically eglandular hairy; style 5–7.5 mm long, pubescent, eglandular in the bottom half, becoming predominantly glandular in the top half; stigma glabrous, 0.5–1.1 mm long. **Fruit** green, 1.5–5 cm long, 1.2–2 mm diameter, glabrous with sparse pubescence at the tip (where the persistent style starts), usually curved at maturity, occasionally straight. **Seeds** brown, narrowly elliptic, 0.3–0.4 \times c. 0.1 mm.

Distribution. Northern and Northeastern Thailand. Laos, India. Likely also to be in Myanmar.

Habitat. On limestone in deciduous forest.

Provisional IUCN conservation assessment. Least Concern LC. This species is known over a wide area and from many localities within Thailand. Its distribution in Myanmar

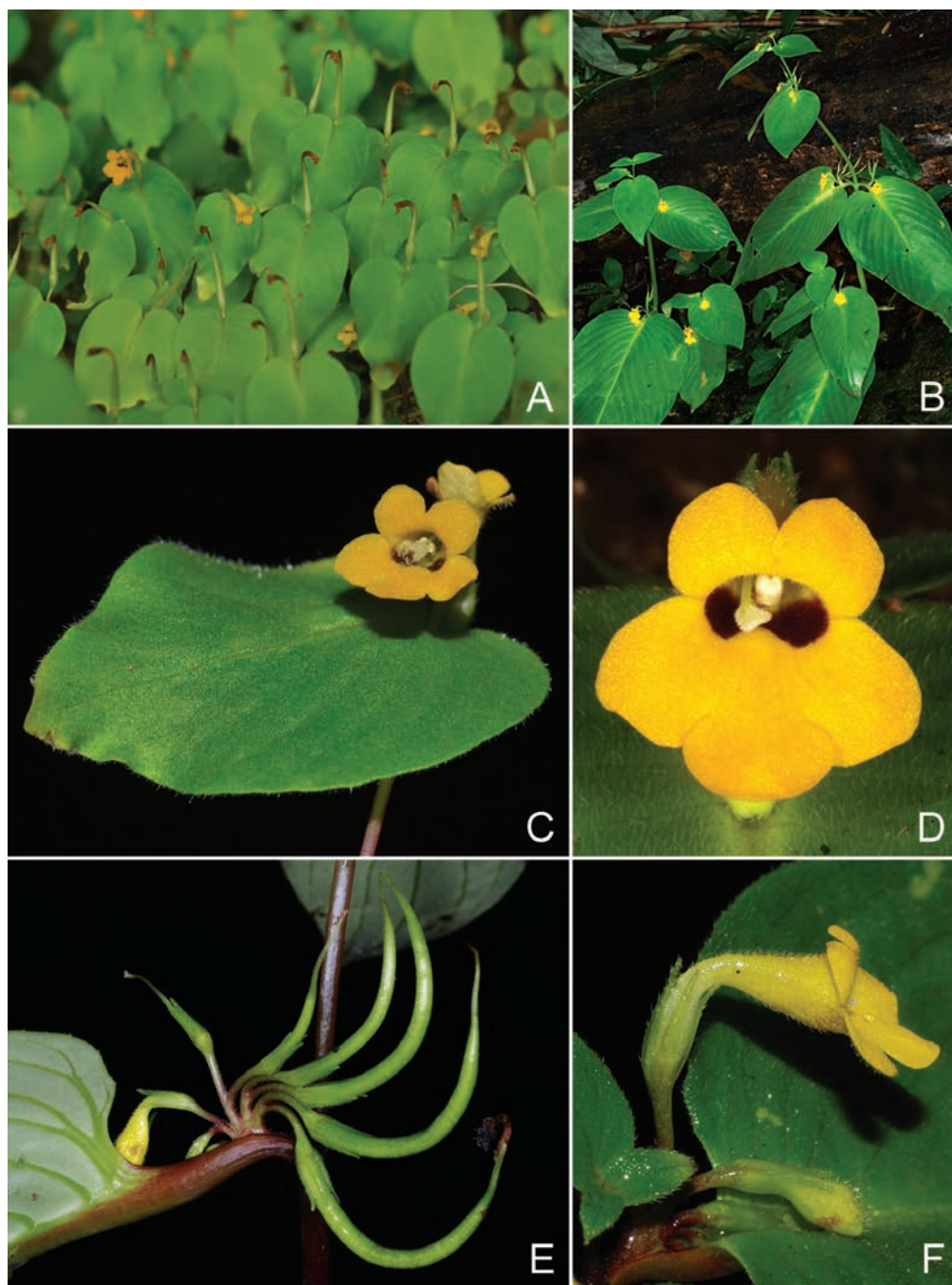


Fig. 4. *Microchirita bimaculata* (D.Wood) A.Weber & D.J.Middleton. **A.** Unifoliate plants. **B.** Caulescent plants. **C.** Detail of a unifoliate plant. **D.** Front view of the flower. **E.** Fruits. **F.** Side view of the flower. A, C from Suddee, S. *et al.* 4970; B from Middleton, D.J. *et al.* 4514; D from Middleton, D.J. *et al.* 4520; E, F from Middleton, D.J. *et al.* 4479. (Photos: A, C, S. Suddee; B, D–F, P. Karaket)

is currently unknown but is likely to occur there. As limestone habitats are threatened throughout the region the status of this species should be monitored.

Additional specimens examined. THAILAND: **Buengkan:** Bung Khla, Phu Wua Wildlife Sanctuary, Tham Foon Waterfall, 167 m, 21 Oct 2015, *Suddee, S. et al.* 4970 (BKF, SING). **Chiang Mai:** Cultivated at RBGE from Burt 5611, *C5927*, (E); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, 28 Aug 1935, *Garrett, H.B.G.* 1280 (K); ibidem, 13 Oct 1926, *Put, N.* 306 (ABD, BM, K); ibidem, *Bunchuai, K.* 260 (BKF); ibidem, 1100–1800 m, 13 Sep 1967, *Tagawa, N. et al.* *T-9916* (BKF); ibidem, 28 Aug 1935, *Garrett, H.B.G.* 1002 (E, K [2 sheets], L, P); ibidem, 1100–1800 m, 13 Sep 1967, *Tagawa, N. et al.* *T-9915* (BKF); ibidem, 9 Nov 1962, *Smitinand, T. et al.* 7734 (BK); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, Ban Chiang Dao, 25 Aug 1990, *Maxwell, J.F.* 90-902 (A, CMU, L); Doi Chiangdao, Ban Tham, 500 m, 14 Aug 1963, *Smitinand, T. & Sleumer, H.O.* 1003 (BKF); Wat Chiang Dao, c. 450 m, 24 Sep 1971, *Murata, G. et al.* *T-14857* (BKF, L); Khao Chiang Dao, 30 Oct 1963, *Bunchuai, K.* 1294 (BKF); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, trail to Tam Chiang Dao, 500 m, 20 Sep 2008, *Middleton, D.J. et al.* 4520 (BKF, E, P, SING); Foot of Doi Chiang Dao, 500–600 m, 11 Sep 1967, *Tagawa, N. et al.* *T-9785* (BKF); Doi Inthanon, Mae Pan Fall, c. 1400 m, Oct 1979, *Santisuk, T. s.n.* (BKF); Chom Tong, Doi Inthanon National Park, Wachirathan Waterfall, 710 m, 19 Sep 2008, *Middleton, D.J. et al.* 4514 (BKF, E); Doi Suthep, 10 Oct 1987, *Maxwell, J.F.* 87-1158 (CMU, L); ibidem, 8 Sep 1958, *Sørensen, T. et al.* 4829 (ABD); ibidem, 1500 ft, 14 Nov 1909, *Kerr, A.F.G.* 897 (BM, K, L, P); ibidem, 2400 ft, 25 Sep 1910, *Kerr, A.F.G.* 1422 (BM, K, L, P); ibidem, 1000 m, 5 Sep 1958, *Sørensen, T. et al.* 4751 (ABD, BKF); Summit of Doi Su Thep, 14 Oct 2003, *Mattapha, S.* 425 (BKF); Mueang Chiang Mai, Doi Suthep-Doi Pui National Park, Montatarhn waterfalls, 1 Nov 2005, *Palee, P.* 882 (A); Doi Suthep-Doi Pui National Park, above Huay Dteung Tau Lake, 825–875 m, 28 Aug 1990, *Maxwell, J.F.* 90-918 (L); East side of Doi Sutep, Kohntatahn Falls, 600 m, 4 Nov 1987, *Maxwell, J.F.* 87-1366 (BKF, CMU, L); Muang Chiang Mai, Doi Suthep-Doi Pui National Park, San Gou, 1030 m, 17 Sep 2008, *Middleton, D.J. et al.* 4479 (BKF, E, P); Hang Dong, Ban Pong, Tham Takkatan (Grasshopper Cave), above Nam Sum (Mong), 850–930 m, 3 Sep 2003, *Maxwell, J.F.* 03-270 (BKF, L); Mae Rim, Pong Yeang, Pong Taa Hoen, 1000 m, 8 Sep 1995, *Nanakorn, W.* 4160 (E, QBG); Mae Rim, Pong Yeang, c. 1100 m, 16 Aug 1994, *Nanakorn, W. et al.* 1348 (E, QBG); Mae Taeng, Doi Pah Dae, 9 Aug 1996, *Maxwell, J.F.* 96-1063 (A, L); Mae Dtang, Geut Chang, Pad Dahn village, Doi Saing Liang, 1025 m, 20 Sep 1997, *Maxwell, J.F.* 97-1011 (A, BKF, L); Mae Taeng, Ban Keud, c. 520 m, 25 Aug 1994, *Nanakorn, W. et al.* 1458 (QBG); Mueang Chiang Mai, 12 Sep 1982, *Fusai, P.* 7 (CMUB); Inthanon, Mae Paarn Falls, 1000 m, 5 Oct 1999, *Suksathan, P.* 2336 (QBG); Mae Wang, Mae Win, Wang Pah Boon, 24 Aug 2004, *Palee, P.* 695 (A). **Lampang:** Chae Hom, Jae Sawn National Park, east side, 525 m, 25 Aug 1995, *Maxwell, J.F.* 95-556 (BKF, L); Chae Hom, Chae Son National Park, Tad Rung, 527 m, 2 Sep 2009, *Norsaengsri, M., et al.* 6042 (QBG); Jae Son National Park, 300 m, 8 Nov 1999, *Suksathan, P.* 1809 (E, QBG); Doi Pang La, Huay Tak, 400 m, 25 Sep 1967, *Shimizu, T. et al.* *T-10790* (BKF); en route from Pang La to Huay Tak, 350 m, 24 Sep 1967, *Shimizu, T. et al.* *T-10724* (BKF). **Lamphun:** Mae Tah, Doi Kuhn Dahn National Park, South side, Doi Hoa Chang, 1225 m, 4 Sep 1994, *Maxwell, J.F.* 94-981 (BKF, L). **Mae Hong Son:** Mae La Noi, road from Mae Sariang to Mae Hong Son, 560 m, 20 Oct 2014, *Middleton, D.J. et al.* 5800 (BKF, E). **Phitsanulok:** Thung Salaeng Luang National Park, Kaeng Sopa Waterfall, 375–410 m, *Murata, G. et al.* *T-38537* (BKF); ibidem, 375–410 m, *Murata, G. et al.* *T-38516* (BKF); ibidem, 17 Sep 1990, *Chantharanothai, P. et al.* 90/298 (K); Thung Salang Luang, *Pinnin, S. et al.* 113 (BKF, E); Thung Salang Luang, S.P. [*Pinnin, S.?*] *et al.* 84 (BKF); Tung Salaeng Luang

National Park, Kang So Pa Waterfall, 350 m, 11 Oct 1979, *Shimizu, T. et al.* T-18365 (BKF). **Tak:** Mae Ramad, Ban Nam Ok-roo, 15 Sep 2005, *Pooma, R.* 5687 (BKF); Tha Song Yang, road to Mae Sariang, 832 m, 19 Oct 2014, *Middleton, D.J. et al.* 5790 (BKF, E); Tha Song Yang, Tham Ook Ru Temple, 100 m, 6 Sep 2013, *Phaosrichai, P. & Wongnak, M.* 21 (QBG).

Notes. This species is broadly distributed across the North of Thailand. It is recognisable by the bright yellow corolla with lateral dark spots inside the throat, the often curved fruit, steep secondary veins, and the dull orange-silver hue of the abaxial side of the dry leaves.

5. *Microchirita elphinstonia* (Craib) A. Weber & D.J. Middleton, *Taxon* 60: 778 (2011). – *Chirita elphinstonia* Craib, *Bull. Misc. Inform. Kew* 149 (1932); Barnett, *Fl. Siam.* 3: 224 (1962); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 195 (1974); Burtt, *Thai Forest Bull., Bot.* 29: 87 (2001). – TYPE: Cult. in Hort. Aberdeen from seeds of Marcan 2561, coll. Thailand, Krabin, Ban Keng, 30 m, limestone hill (lectotype K [K000545615], designated by Wood (1974: 195); isolectotypes A [00054810], ABD, B [B100277728], BK, BR [692324], C [C10012723], CHR [CHR213604], E [E00155273], L, LE [LE00017212] P [P00602511], SING, US [00126000]).

Caulescent herb to 50 cm tall, internodes 3–10 cm long. **Stems** succulent, glabrous, branching from the petioles. **Leaves** opposite, apart from the basal leaf, but sometimes 2 single basal leaves are present; petioles 0.5–1.4 cm long, sparsely eglandular hairy; blades ovate, 1–10.5 × 2–6.3 cm (paired leaves, basal leaf not measured), 1.5–1.8 times as long as wide, base shortly attenuate to seemingly cordate, apex acute to shortly acuminate, with short eglandular hairs above and very sparse hairs beneath, minutely ciliate along the margin, margin entire, 4–21+ pairs of secondary veins. **Inflorescences** cristate, can be congested and many-flowered; peduncles 0.2–5 mm long, fused with each other, glabrous and curved; bracts absent; pedicels 8–12 mm long, glabrescent or sparsely hairy, curved. **Calyx** pale green, actinomorphic, tube 0.5–1 mm, lobes elliptic, 8–15 × 1.5–1.9 mm, apex narrowly acute, margin entire, sometimes with indistinct small teeth near the apex, eglandular hairy outside, especially on tip and margin, inside with sessile glands. **Corolla** 20–30 mm long, bright yellow, with lateral dark spots in throat, tube narrow, curved, then progressively widening, lobes spreading, eglandular hairy outside, lobes papillose, ventral lobe prominent; tube 17–21 mm long dorsally, 17–20 mm ventrally, 17–23 mm laterally between lips; lobes elliptic, apices obtuse to rounded, margin irregular, upper lobes 2–4.5 × 5–6 mm, lateral lobes 5–7 × 6–7.5 mm, ventral lobe 8–10 × 6.5–10 mm. **Stamens** arising 9.5–12 mm above the corolla base; filaments geniculate or twisted in the middle, pale in the lower half, darker above, glabrescent or sparsely hairy below the knee, glandular above, 4–5 mm long, 0.3–0.5 mm wide; anthers yellow, with long eglandular hairs dorsally, 2.5 × 1.7–2.5 mm, apically joined by a connective, thecae divergent; staminodes not seen. **Disk** partial, 0.4–0.5 mm high, or complete and 0.6–0.8 mm long. **Pistil** 18.5–20 mm long; ovary 5–8 mm long, 0.7–1.2 mm diameter, glabrous at the base, hairy apically; style

7–10 mm long, hairy, becoming glabrescent towards apex; stigma glabrous, 0.5–0.6 mm long. **Fruit** straight or curved, 4–6.5 cm long, sparsely hairy. **Seeds** dark brown, elliptic, $0.4\text{--}0.5 \times 0.2\text{--}0.3$ mm.

Distribution. Northeastern to Southeastern Thailand. Cambodia.

Habitat. On limestone in evergreen forest.

Provisional IUCN conservation assessment. Endangered EN B2ab(iii). Although this species has a large EOO, it is known from rather few collections and has a currently known AOO well within the range for an Endangered status, coupled with a fragmented distribution and the many threats to limestone habitats throughout the region from mining, tourism and land use changes. Within the EOO there are rather limited opportunities for the AOO to increase beyond the threshold for Endangered due to the lack of suitable habitats.

Additional specimens examined. **Unknown origin:** Cultivated at RBGE from material grown at University Botanic Garden, Utrecht, acc. 800333, P12, Nov 1980, *C13665* (E); Cultivated at RBGE from material grown at University Botanic Garden, Utrecht, acc. 800335, P12, Nov 1980, *C13667* (E); Cult Cantonspark, *Mennega*, *E.A.* 61-70 (E); *Entry s.n.* (K [2 sheets]); Cultivated in Hort. Aberdeen, 1931, “*Kerr*” 337 (L); Cultivated in Hort. Aberdeen, 1931, “*Kerr*” 338 (L). THAILAND: **Khon Kaen:** Phu Pha Man, Tadyai Waterfalls, 18 Nov 2011, *Lakoet*, *C.* 237 (QBG). **Loei:** Phu Luang Wildlife Reserve, Nam Tok to Pa Paw trail, 29 Sep 1990, *Chantaranothai*, *P. et al.* 90/439 (BKF, K). **Nong Khai:** Ban Phu Ngam, Singhanat Ban Phot temple, 150 m, 26 Aug 2001, *Pooma*, *R. et al.* 2686 (BKF [2 sheets]). **Prachin Buri:** Krabin, Kao Sungto, c. 50 m, 10 Nov 1930, *Marcan*, *A.* 2561 (ABD [2 sheets], BK, BM [2 sheets], K [2 sheets], E); Cultivated at Smithsonian Institution from Marcan 2561, accession 78-139, *Skog*, *L.E.* & *Staton-Hodapp*, *S.* 5333 (US). **Sa Kaeo:** Khao Chakan Temple, 88 m, 17 Oct 2010, *Staples*, *G. et al.* 1407 (BKF, E, K, SING). **Sisaket:** Khun Han, Sam Rongkiat Falls Arboretum, 200 m, 22 Dec 2005, *Pooma*, *R. et al.* 6094 (BKF, E).

Notes. *Microchirita elphinstonia* is a yellow-flowered species recognisable by the filament, which is somewhat divided in two halves (it can be geniculated or more commonly twisted), and appears darker in the upper part than in the lower in dry specimens. The leaves are ovate and the secondary veins can be numerous and very close to each other, although this is not a consistent character, e.g. in the type material.

6. *Microchirita glandulosa* C.Puglisi, **sp. nov.**

Similar to *Microchirita involucrata* (Craib) Yin Z.Wang and *M. rupestris* (Ridl.) A.Weber & Rafidah) in having bracteate inflorescences. Differs from both in the bracts being fused only at the base (i.e. not divided as in *Microchirita involucrata* and not fused into a cup as in *M. rupestris*), in the dimorphic indumentum of sparse, long eglandular hairs and dense short glandular hairs on the leaf (eglandular indumentum in *M. involucrata* and *M. rupestris*), and in the tripartite calyx. It differs further from

Microchirita involucrata in the serrate margin of the bracts and from *M. rupestris* in the much smaller size of the bracts. – TYPE: Thailand, Nan, Song Kwaw, Sakoen, Khao Tham Plakang, 750 m, 3 September 2006, *Watthana*, S. 2126 (holotype QBG; isotype CMU).

Herb to 50 cm tall. **Stems** fleshy, sparsely glandular hairy. **Leaves** opposite, with the exception of the single basal leaf; petioles 0.1–2 cm long, glandular hairy and with sparse long eglandular hairs; blades lanceolate, $2\text{--}8.5 \times 1\text{--}6.5$ cm, 1.3–2.2 times as long as wide, base cordate or obtuse, apex acute, with a dimorphic indumentum of dense and short glandular hairs and longer and thicker eglandular hairs, margin delicately serrate, 8–10 pairs of secondary veins in the opposite leaves, tertiary venation inconspicuous. **Inflorescence** 1–3-flowered, arising from the axil end of the petiole; peduncles 2–8 mm long, glandular hairy; bracts fused at the base and enclosing the pedicels, $0.6\text{--}1.1 \times 0.3\text{--}0.5$ mm, sessile or shortly petiolate, margin and indumentum matching those of the leaves; pedicels 0.8–1.2 cm long, covered in minute glandular hairs. **Calyx** zygomorphic, tube 1.5 mm dorsally, 1 mm laterally and 0.5 mm ventrally, lobes linear to oblanceolate, $4.5\text{--}7.5 \times 0.8\text{--}2.2$ mm, minutely toothed towards the apex, apex acute, densely glandular hairy outside and inside. **Corolla** 15–18 mm long, reportedly white, tube with a narrow basal portion, slightly curved downwards, then progressively broadening, externally with a minute glandular indumentum; tube c. 12.5 mm long dorsally, 15–16 mm ventrally, 13 mm laterally between lips; upper lobes elliptic, c. 1.5×2.5 mm, lateral and lower lobes seemingly small but not measured. **Stamens** arising c. 7 mm above the corolla base; filaments glabrous, c. 3.5 mm long, S-shaped; anthers with a dense indumentum at the insertion, c. 1.3×2.5 mm, apically joined by a connective, thecae subparallel; lateral staminodes c. 0.5 mm long, arising c. 6.5 mm above the corolla base, central staminode c. 0.7 mm long, arising c. 6.5 mm above corolla base. **Disk** annular, 0.4–0.5 mm high. Pistil 12–14 mm long; ovary 5–6 mm long, c. 1.5 mm diameter, with minute glandular hairs throughout its length, except for the lowermost half millimetre, which is glabrous; style c. 6 mm long, covered in the same indumentum as the ovary; stigma lobes c. 1.5 mm long, glabrous. **Fruit** and seeds not seen.

Distribution. Northern Thailand (Nan).

Habitat. On exposed limestone.

Provisional IUCN conservation assessment. Data Deficient DD. This species is only known from a single collection from a National Park. There is extensive but underexplored limestone in the region and more information is needed on the distribution of the species and on potential threats before a satisfactory conservation assessment can be given.

Notes. The epithet refers to the conspicuous presence of a glandular indumentum.

7. *Microchirita hamosa* (R.Br.) Yin Z.Wang, J. Syst. Evol. 49: 60 (2011). – *Chirita hamosa* R.Br., Cyrtandreae 117 (1839); Barnett, Fl. Siam. 3: 224 (1962); Wood, Notes Roy. Bot. Gard. Edinburgh 33: 191 (1974); Burt, Thai Forest Bull., Bot. 29: 87 (2001). – TYPE (conserved – see Middleton & Puglisi, 2015): Thailand, Tak, Umphang, Umphang [Doi Hua Mot] Wildlife Sanctuary, 915 m, 17 October 2014, Middleton, D.J., Hemrat, C., Karaket, P., Puglisi, C. & Suddee, S. 5762 (holotype E; isotypes BKF, SING). (Fig. 3C–F)

Caulescent herb to 25 cm tall; internodes 3–6 cm, although more often than not appearing as a unifoliate plant. **Stems** fleshy, with long eglandular hairs, pale green or sometimes tinged with purple-brown. **Leaves** opposite, except for the single basal cotyledon; petioles 0.1–0.5 cm long, densely hairy; blades green above, pale green beneath, ovate to lanceolate, 2–13.3 × 1.1–9.3 cm, 1.2– 2.1 times as long as wide, base of macrocotyledon/basal leaf cordate, cauline leaves shortly attenuate, apex acute, densely eglandular tomentose above and beneath, margin entire or subentire, 6–12 pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, tertiary venation laxly reticulate. **Inflorescences** cristate, few to many flowered; peduncles to 4 mm long, not fused with each other; bracts absent; pedicels pale green, 3–20 mm long, all axes with long eglandular hairs. **Calyx** green, regular, tube 0.1–0.3 mm, lobes narrowly lanceolate, 3–4.5 × 0.4–0.7 mm, eglandular hairy outside, glabrous inside except at the tip, apex acuminate, margin entire. **Corolla** 8.5–13 mm, white with a yellow stripe ventrally in tube, tube tubular, not curved downwards, lobes not spreading, outside eglandular hairy, glabrescent, becoming densely eglandular hairy towards the lobes, inside densely glandular, especially on lobes; tube 8–9 mm long, equal dorsally, laterally and ventrally; upper lobes 0.7 × 1 mm, lateral lobes 1.1 × 1.1 mm, lower lobe 1 × 0.7 mm. **Stamens** arising c. 3.9 mm above the corolla base; filaments white or pale yellow, straight, glabrous, c. 1.5 mm long, 0.1 mm wide; anthers white or pale yellow, glabrous, 0.6–1.1 × 1–2 mm, free, thecae divergent; staminodes not seen. **Disk** a single ventral lobe, 0.1 mm. **Pistil** c. 16 mm long; ovary c. 14 mm long, c. 0.7 mm diameter, glabrous or papillose in lower 1/3, densely pubescent in upper 2/3, many ovules; style c. 3 mm long, densely pubescent; stigma shallowly bilobed, c. 0.2 mm long. Style and stigma green to white. **Fruit** green, 1.2–2 cm long, 1–1.2 mm diameter, glabrous at the base, then becoming densely eglandular hairy, straight or slightly curved. **Seeds** dark brown, elliptic, 0.2–0.3 × 0.1–0.2 mm.

Distribution. Northern and Northeastern Thailand. India, China, Myanmar, Laos, Vietnam.

Habitat. On limestone rocks or sandy soil in dry dipterocarp forest.

Provisional IUCN conservation assessment. Least Concern LC. This species is common and widespread although could potentially be impacted by removal of limestone habitats for cement.

Additional specimens examined. **Unknown locality:** Cultivated in Cantonspark, Utrecht (NL), 19 Aug 1964, *Mennega*, accession 62-1556 (E). Kerr, A.F.G. 2174 (E). THAILAND: **Bueng Kan:** Bungkhla, Phu Wua Wildlife Sanctuary, 200 m, 27 Aug 2001, *Pooma, R. et al.* 2796 (BKF). **Chiang Mai:** Chom Tong, Mae Soi Valley, Pa Peung area, 675 m, 1 Oct 1991, *Maxwell, J.F.* 91-816 (E, L, P); Chiang Dao, road to WiangHaeng, 700 m, 21 Sep 2008, *Middleton, D.J. et al.* 4540 (BKF, E); Chiang Dao, Ban Pak Chiang, 31 Oct 1963, *Adisai* 586 (BK); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, 500 m, 20 Sep 2008, *Middleton, D.J. et al.* 4519 (BKF, E, P); Chiang Dao, Doi Chiang Dao Animal Sanctuary, north side of Doi Luang, 975 m, 11 Oct 1995, *Maxwell, J.F.* 95-901 (BKF, CMU, L); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, Tam Pha Phlong, 600 m, 20 Sep 2008, *Middleton, D.J. et al.* 4522 (BKF, E); Chiang Dao, Tham Chiang Dao, 9 Sep 1999, *Srisanga, P. et al.* 1020 (QBG); Chiang Dao, Kio Phawok border checkpoint, 30 Sep 2009, *Middleton, D.J. et al.* 5016 (BKF, E, P, SING); Doi Chiang Dao, Pa Blawng Cave area, 550 m, 21 Oct 1989, *Maxwell, J.F.* 89-1283 (L). Mae Teng, Pa Pae, Mok Fah Waterfalls, 620 m, 13 Sep 1999, *Srisanga, P. & Puff, C.* 1070 (BKF, E, QBG); Mae On, Mae On Cave, 500 m, 7 Sep 2011, *Pooma, R. et al.* 7796 (BKF, E [2 sheets]); Sangaapang, Muang Awn Cave, 525 m, 12 Oct 1989, *Maxwell, J.F.* 89-1217 (A, CMUB, L); San Kamphaeng, Sahagon, Doi Muang Awn, 15 Sep 1998, *Palee, P.* 407 (CMUB); Mae Ping Rapids, 26 Nov 1920, *Kerr, A.F.G. s.n.* (BM); Payap, Sop Aep, *Hennipman, E.* 3346 (L). **Chiang Rai:** Doi Tam Yup, c. 390 m, 14 Sep 1924, *Garrett, H.B.G.* 198 (ABD [2 sheets], BK, BM, K [2 sheets]). **Kamphaeng Phet:** Khlong Lan, Khlong Lan National Park, Khong Lan Waterfalls, 200 m, 4 Nov 2010, *Pooma, R. et al.* 7469 (BKF). **Lamphun:** Mae Tah, Doi Khun Dahn National Park, Daht Muey Falls, 800 m, 23 Oct 1993, *Maxwell, J.F.* 93-1269 (A, BKF, CMU); Mae Tah, Doi Khun Dahn, Daht Muey Waterfall, 775 m, 30 Sep 2001, *Palee, P.* 497 (A, BKF, CMU); Mae Tah, Doi Khun Dahn National Park, Tah Goo station area, 650 m, 28 Oct 1994, *Maxwell, J.F.* 94-1130 (A, BKF, CMU, L). **Loei:** Mueang Loei, Phu Pha Lom Temple, 402 m, 9 Sep 2014, *Tetsana, N. et al.* 797 (BKF, SING). **Mae Hong Son:** 600 m, 10 Sep 1974, *Larsen, K. & Larsen, S.* 34337 (AAU); Mae La Noi, road from Mae Sariang to Mae Hong Son, 560 m, 20 Oct 2014, *Middleton, D.J. et al.* 5801 (BKF, E); Pangmapha, Tahm Lawt, Nam Lawng River, 675 m, 7 Aug 1999, *Maxwell, J.F.* 99-111 (CMU, E, L); Bang Ma Pah, Ban Jah bo, Mae La Nah Cave, 950 m, 30 Sep 2003, *Palee, P.* 632 (A, CMUB); Bahng Ma Pah, Tahm Lawt, Doi Pah Baw, above Muang Pam village, 750 m, 10 Nov 2004, *Palee, P.* 771 (A, CMUB); Muang Mae Hong Son, Pha Suea Waterfall National Park, Tham Pla, 225 m, 21 Oct 2014, *Middleton, D.J. et al.* 5808 (BKF, E); Doi Pui, 800 m, 23 Sep 1995, *Larsen K. et al.* 46859 (AAU). **Nan:** Bo Kluea, Doi Phu Kha National Park, 1210 m, 15 Aug 2012, *Middleton, D.J. et al.* 5607 (BKF, E); Song Khwae, Tham Sakoen National Park, 700 m, 14 Aug 2012, *Middleton, D.J. et al.* 5598 (BKF, E, P, SING); Song Kwae, Tham Sakoen National Park, Pha Than Waterfalls, 16 Jul 2012, *La-ongsri, W. et al.* 2417 (QBG); Song Kwae, Tham Sakoen National Park, Tham Hai Tak, 689 m, 27 Jul 2011, *La-ongsri, W. et al.* 1830 (QBG); Pua, Doi Phu Kha National Park, 1250 m, 1 Sep 2000, *Srisanga, P.* 1572 (E, QBG). **Sakhon Nakon:** Pha Nang Moen, Phu Phan National Park, 31 Jul 1999, *Newman, M.F.* 947 (BKF, E).

Notes. This species is recognisable by the small, white flower with a tubular corolla, and by the relatively short and densely hairy fruit. It is widespread across the north of Thailand and in the neighbouring countries. It frequently flowers when only a unifoliate plant.

Microchirita hamosa is conserved with a conserved type (proposed by Middleton & Puglisi, 2015; supported by Nomenclature Committee for Vascular Plants in Applequist, 2016).

Wood (1974) listed a number of synonyms for *Chirita hamosa*, all from India. As noted by Middleton & Triboun (2013), several different species were included in Wood's concept of *Chirita hamosa* so we refrain from listing any of these synonyms pending a thorough revision of the genus in India.

8. *Microchirita hemrattii* C.Puglisi, Kew Bull. 71(1)-2: 4 (2016). – TYPE: Thailand, Tak, Mae Sot distr., Wat Tham Inthanin, 660 m, 18 October 2014, *Middleton, D.J., Hemrat, C., Karaket, P., Puglisi, C. & Suddee S.* 5775 (holotype BKF; isotypes E [E00663027], SING). (Fig. 5A–B)

Herb to 50 cm tall. **Stems** fleshy, dark red or green at base, otherwise pale green, glabrous or sparsely hairy. **Leaves** opposite, with the exception of the single basal leaf, fleshy (very thin when dry); petioles 0.2–1.5 cm long, glabrous; blades pale green above, paler beneath, lanceolate, 3.75–14 × 2.6–8.5 cm, 1.3–1.7 times as long as wide, base obtuse to cordate, apex acute to acuminate, sparsely and minutely tomentose above and beneath, above with additional scattered eglandular hairs, margin entire to obscurely serrulate, 3–8 pairs of secondary veins in the opposite leaves, 7–13 in the basal leaf, venation raised beneath in fresh material, tertiary venation almost invisible. **Inflorescence** 1–8-flowered, cristate; peduncles reduced; bracts absent; pedicels green, 0.5–1.3 cm long, sparsely eglandular hairy. **Calyx** green, actinomorphic, tube 0.2–0.5 mm long, lobes lanceolate, 3–9 × 0.5–1 mm, inconsistently with some serration towards the apex, apex acute, outside sparsely eglandular hairy at base, hairier distally, inside with an indumentum of sparse sessile glands. **Corolla** 10–15 mm long, narrow basal portion greenish white, rest of tube white, with a yellow stripe ventrally inside, lobes pale lilac, tube with a narrow basal portion, then broadening into a funnel-shaped distal portion, this curved down, pubescent outside except at base, inside glabrous, the upper lobes densely covered in stalked glands, the lower central lobe sparsely so, the lower lateral lobes glabrous; tube 9–12 mm long dorsally, 10–11 mm ventrally, 8.5–9 mm laterally between lips, upper lobes broadly elliptic, 2.5–3 × 4–4.7 mm, lower lateral lobes elliptic, 2–4 × 4–5 mm, lower central lobe rounded, 3–4 × 4–5 mm. **Stamens** arising 4–6.5 mm above the corolla base, filaments glabrous, 3–3.5 mm long, straight; anthers with a dense indumentum of long hairs dorsally, c. 1 × 0.7–0.8 mm, apically joined by a connective, thecae divergent; lateral staminodes c. 2 mm long, arising 3–5 mm above the corolla base, central staminode c. 1 mm long, arising c. 4 mm above corolla base. **Disk** absent. **Pistil** 8–12 mm long; ovary 3–5 mm long, papillose, with pubescence restricted to the apex; style 5–6 mm long, apically curved, hairy; stigma with lobes c. 0.5 mm long, c. 0.8 mm wide, narrowly elliptic, glabrous. **Fruit** green, 2–6 cm long, 0.9–1.1 mm diam., glabrous at the base, sparsely hairy distally, straight or curved. **Seeds** light brown with reddish apices, elliptic, 0.5–0.6 × 0.2–0.3 mm.

Distribution. Northern Thailand (Tak).

Habitat. On limestone in deciduous forest.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii,iv) + B2ab(iii,iv). The known EOO of this species would qualify it for Critically Endangered but the collecting localities are in a limestone range much of which has so far not been explored and where it is also likely to occur. Even if it were to occur throughout this range its EOO would still qualify it as Endangered. Parts of this range, including some of the known localities, are outside protected areas and subject to disturbance from visitors, particularly at the religious sites.

Additional specimens examined. THAILAND: **Tak:** Mae Sot, Tham Inthanin Temple, 640 m, 17 Oct 2013, *Pooma, R. et al.* 7851 (BKF, E); ibidem, 650 m, 5 Nov 2010, *Pooma, R. et al.* 7522 (BKF); ibidem, 500 m, 11 Sep 2009, *Middleton, D.J. & Triboun, P.* 4849 (BK, E); Maesot, Phra Wo, Phra Wo Spirit House, 700 m, 5 Nov 2010, *Pooma, R. et al.* 7507 (BKF); Mae Sot, Mae Kah Soh, Po Tip Tawng Cave, 300 m, 20 Aug 1994, *Maxwell, J.F.* 94-905 (A, BKF, L).

Notes. This species is recognisable by the pale lilac corolla with a yellow ventral line, the broad mouth, and the dense anther indumentum. It is currently known only from the Mae Sot district of Tak province.

9. *Microchirita huppatatensis* C.Puglisi, Kew Bull. 71(1)-2: 2 (2016). – TYPE: Thailand, Uthai Thani, Lan Sak, Huppatat Non Hunting Area, 122 m, 14 October 2014, *Middleton, D.J., Hemrat, C., Karaket, P., Puglisi, C., Suddee, S.* 5689 (holotype BKF). (Fig. 5C–D)

Herb to 40 cm tall. **Stems** fleshy, red at base and around the basal nodes, otherwise pale green, pubescent. **Leaves** opposite, with the exception of the single basal leaf; petioles 0.5–1.2 cm long, pubescent; blades pale green above, paler beneath, lanceolate or elliptic, 5–12.8 × 1.6–6.1 cm (undamaged basal leaf not seen), 2–3 times as long as wide, base acute to obtuse, apex acuminate, minutely tomentose above and beneath, margin entire, 5–9 pairs of secondary veins in the opposite leaves, at least 13 in the basal leaf, venation raised beneath in fresh material, tertiary venation barely visible and loosely reticulate. **Inflorescence** cristate, 4–15-flowered; peduncles reduced, rarely emerging and fused together at the base; bracts absent; pedicels pale green, 0.2–2 cm long, pubescent. **Calyx** pale green, actinomorphic, tube 0.3–0.5 mm long, lobes narrowly lanceolate, 8–9 × 0.7–1.1 mm, apex acute, outside hairy throughout, with mixed glandular and eglandular hairs, inside with a sparse minute glandular indumentum. **Corolla** 15–20 mm long, base of tube greenish white, rest of tube white, ventral pouch of tube marked by a yellow, raised and papillose line running throughout the inner surface of the tube, with a purple-brown streak on either side of it, tube with a narrow basal portion, curved downwards, then abruptly broadening into a ventral pouch, upper lobes reflexed, lower lateral lobes spreading, the central lobe straight, limb externally sparsely hairy, with stalked glands at the base; tube 9–10 mm long

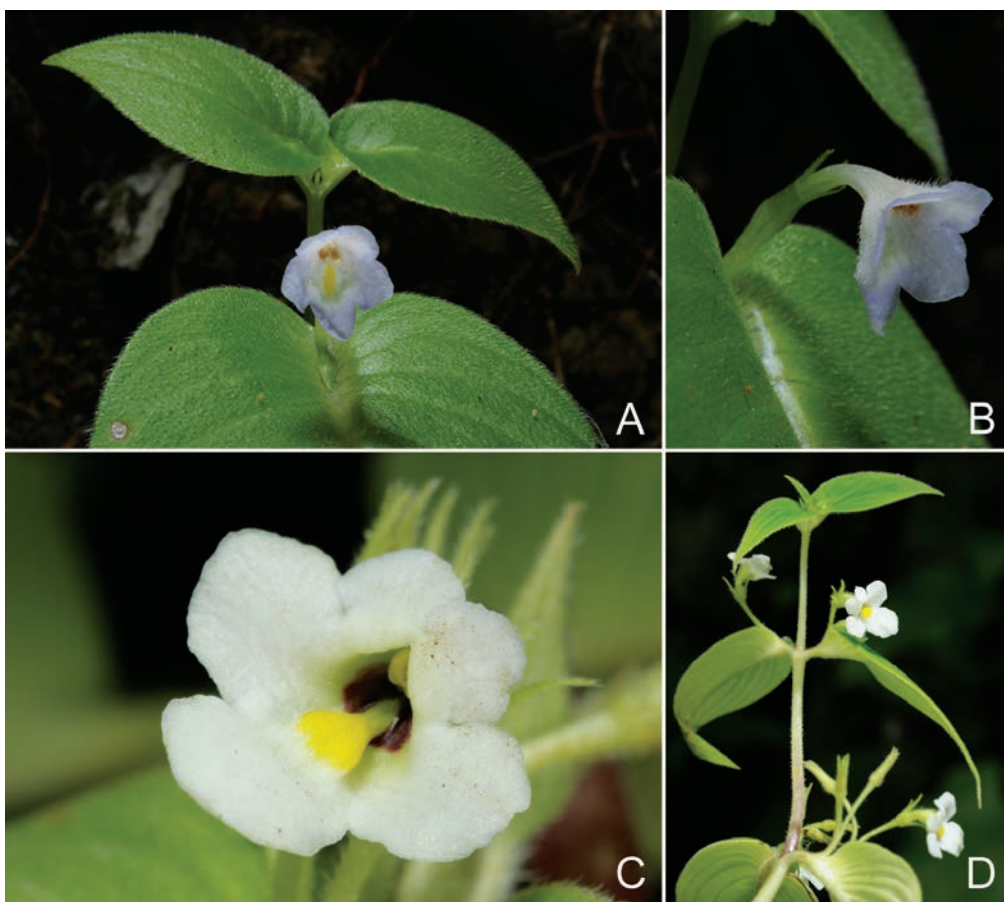


Fig. 5. *Microchirita hemrattii* C.Puglisi. **A.** Front view of flower. **B.** Side view of the flower. All from Middleton, D.J. et al. 5775. *Microchirita huppatatensis* C.Puglisi. **C.** Detail of the flower. **D.** Habit. All from Middleton, D.J. et al. 5689. (Photos: P. Karaket)

dorsally, 10–14 mm ventrally, c. 10 mm laterally between lips, upper lobes elliptic, $3\text{--}3.5 \times 3.5\text{--}4$ mm, lower lateral lobes elliptic, $5\text{--}6 \times 4\text{--}5$ mm, lower central lobe rounded, $6\text{--}8 \times 5\text{--}8$ mm. **Stamens** arising 4–6 mm above the corolla base, filaments yellow, minutely glandular, 1–1.5 mm long, with a thicker base and two geniculations; anthers yellow, connective white, with a small patch of short hairs dorsally, $1.5\text{--}2 \times 1.2\text{--}1.5$ mm, held at a right angle, apically joined by a connective, thecae parallel; all three staminodes much reduced, less than 0.5 mm long, arising 5–6 mm above the corolla base. **Disk** an annular ring, slightly lobed, 1–1.3 mm high, whitish at base and darker along the edge. **Pistil** c. 5 mm long; ovary 2.5–3.5 mm long, glabrous in the basal 2/3, apically eglandular hairy; style 0.5–0.7 mm, glabrous; stigma with lobes 0.5–0.7 mm long, 0.4–0.6 mm wide, elliptic. Immature **fruit** pale green, c. 1.5 cm long, 2–3 mm diam., pubescent throughout its length, straight. **Seeds** not seen.

Distribution. Northern Thailand (Tak).

Habitat. On limestone in secondary forest.

Provisional IUCN conservation assessment. Critically Endangered CR B1ab(iii,iv) + B2ab(iii,iv). This species is only known from the type collection growing in a mixed population with *Microchirita personata*. The limestone range there is only about 12 km² in total and is subject to disturbance from tourism. There are no collections from the nearby Khao Pha Ra, and the area is surrounded by cultivated land.

Notes. *Microchirita huppatatensis* is most similar to *M. woodii* D.J.Middleton & Triboun in the pattern of the corolla colour, but differs in the shorter corolla tube, acuminate leaves and the overall corolla shape. The description and measurements reported here match the original description (Puglisi et al., 2016), as no new specimens have been collected since.

10. *Microchirita hypocrateriformis* C.Puglisi, sp. nov.

Differs from all other species of *Microchirita* (C.B.Clarke) Yin Z.Wang in the combination of long, narrow corolla tube, abruptly opening into spreading limb, in the long lower corolla lobe, and in the presence of a fringe of glandular indumentum at the base of the upper lip. – TYPE: Thailand, Chaityaphum, Khon Sarn, Wat Tham Huang Po, 400 m, 19 October 2015, *Suddee, S., Keiwbang, W., Hemrat, C.* 4967 (holotype BKF; isotype SING). (Fig. 6)

Herb to 50 cm tall with elongated stem runners. Habit caulescent, internodes 4–10 cm. **Stems** succulent, with sparse eglandular indumentum; branches sometimes arising from the petiole of the basal leaf. **Leaves** opposite, apart from the basal leaf; petioles 3–7 mm long, sparsely eglandular hairy; blades pale green above, paler beneath, lanceolate to elliptic, 3.5–22.5 × 2.4–17.5 cm, 1.1–2.4 times as long as wide, base shortly attenuate to cordate, apex acute to acuminate, sparsely eglandular tomentose above and beneath, ciliate along the margin, margin entire or sparsely and minutely denticulate, 5–17 pairs of secondary veins in the opposite leaves, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation inconspicuous. **Inflorescences** cristate, peduncles reduced or to 6 mm long, not fused with each other, bracts absent; pedicels pale green, 0.5–2.5 cm long, pubescent. **Calyx** green, the two lips completely divided, ventral tube c. 1 mm long, dorsal tube c. 0.3 mm long, lobes ligulate to lanceolate, 12–15 × 1.7–3 mm, apex acute and slightly thickened, margin entire or with 1–few minute teeth, succulent at the base, eglandular hairy on both sides, outside with a dimorphic indumentum of fine and large eglandular hairs, inside hairy only towards the tip. **Corolla** 20–25 mm long, tube white outside, limb white or dark violet-blue with a bright yellow/orange stripe inside tube ventrally, which can almost circle the throat, tube narrow, more or less curved, abruptly opening up into spreading lobes, tube glabrous, lobes eglandular pubescent outside, inside with a

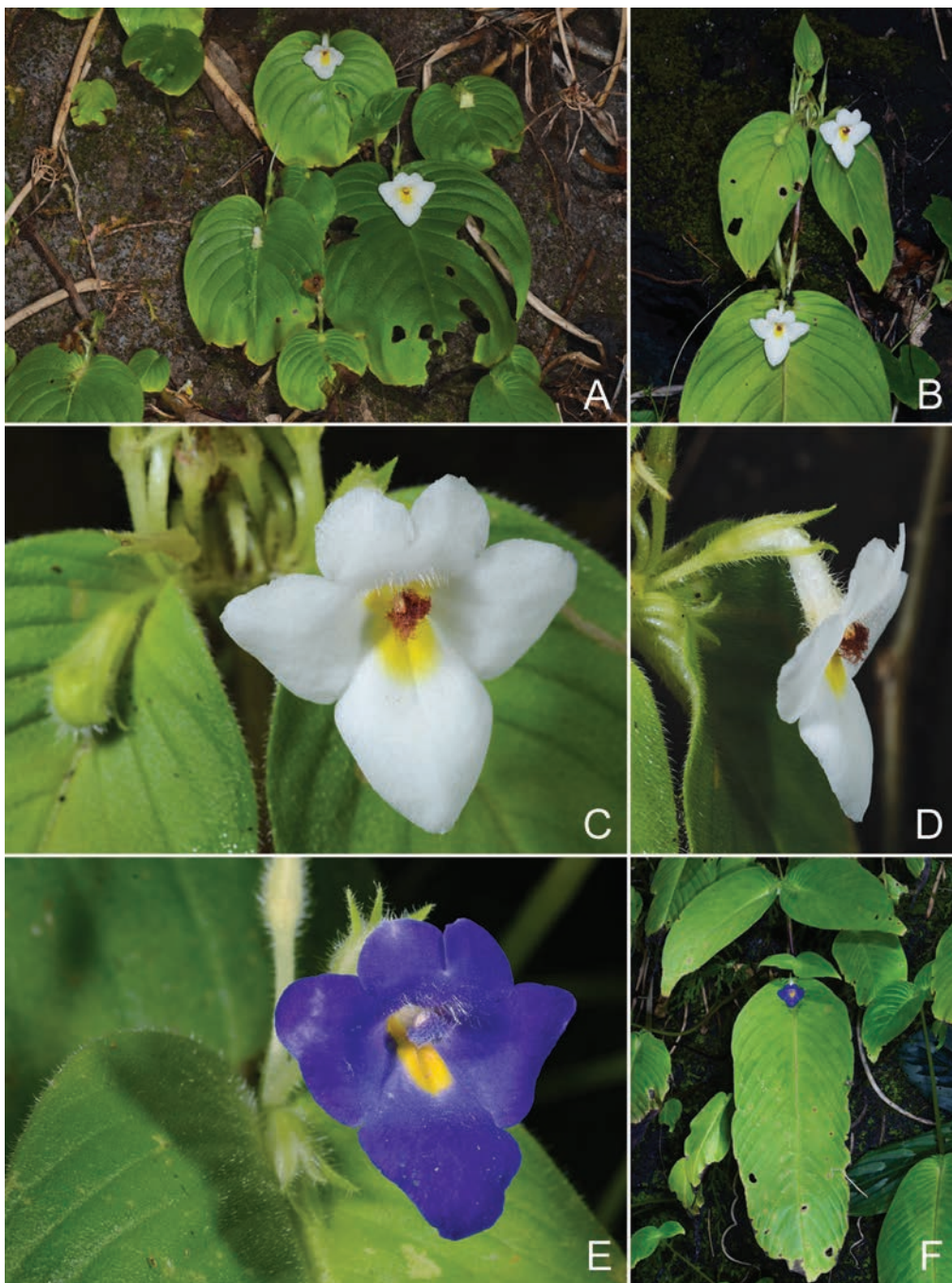


Fig. 6. *Microchirita hypocrateriformis* C.Puglisi. **A.** Unifoliate plants. **B.** Caulescent plant. **C.** Front view of a white flower. **D.** Side view of the flower. **E.** Front view of a blue flower. **F.** Blue-flowered caulescent plant. A–D from *Tetsana, N. et al.* 888; E, F from *Tetsana, N. et al.* 834. (Photos: N. Tetsana)

fringe of fine translucent glandular hairs and glands at the base of the upper lobes, and glands and short hairs over the yellow ventral stripe; tube 15–17 mm long dorsally, 17–21 mm ventrally, 15–19 mm laterally between lips; upper lobes broadly elliptic, $4.2\text{--}5 \times 6\text{--}7$ mm, lateral lobes broadly ovate, $4\text{--}9 \times 8\text{--}9$ mm, ventral lobe ovate, $6\text{--}9 \times 9\text{--}12$ mm. **Stamens** arising 1–1.25 cm above the corolla base, filaments straight, white, glabrous, 2–2.5 mm long, 0.4–0.7 mm wide; anthers white or pale yellow, with an abundant indumentum of coloured hairs (blue in blue-flowered specimens, brown in white-flowered specimens) above and dorsally, 2.3×1.3 mm, apically joined by a connective, thecae more or less parallel; lateral staminodes 0.6–1.1 mm long, arising c. 4.5–8.5 mm above the corolla base, central staminode 0.1–0.7 mm long, arising 5–8.5 mm above the corolla base. **Disk** annular, slightly lobed, 0.4–1 mm high. **Pistil** c. 23 mm long; ovary 0.6–1.4 cm long, c. 1 mm diameter, glabrous in the basal 0.5–3 mm, then densely eglandular hairy; style c. 0.9 cm, sparsely eglandular hairy; stigma with a weakly bilobed lower lip, densely hairy, 1–1.6 mm long. **Fruit** green, brown when ripe, 2–3.7 cm long, c. 0.6 mm diameter, eglandular hairy, straight. **Seeds** brown, narrowly elliptic, $0.3\text{--}0.4 \times$ c. 0.1 mm.

Distribution. Eastern and Northeastern Thailand.

Habitat. On limestone in mixed deciduous forest.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii) + B2ab(iii). The known EOO is < 500 km² and the known AOO is only 12 km². Not all of the known localities are in protected areas and those that are not are subject to disturbance from visitors.

Additional specimens examined. THAILAND: **Chaiyaphum:** Khon Sarn, Wat Huang Po, 378 m, 7 Nov 2014, *Tetsana, N. et al.* 888 (BKF, SING); Khon Sarn, Wat Pa Thum Thep Nimit Doi Kitchakoot, 484 m, 12 Sep 2014, *Tetsana, N. et al.* 834 (BKF, SING). **Loei:** Nong Hin, Suan Sa Wan, Pha Ngam Forest Park, 662 m, 11 Sep 2014, *Tetsana, N. et al.* 824 (BKF, SING).

Notes. The epithet refers to the narrow corolla tube. Most of the specimens observed have pure white corollas, a yellow ventral stripe, and brown anther indumentum. The specimen *Tetsana, N. et al.* 834, instead, has a blue-purple corolla, with similarly coloured anther indumentum and a yellow ventral stripe. The morphology of the white and blue forms are otherwise identical, and no intermediate colour variants have been observed.

The collection from Loei, *Tetsana et al.* 824, has a longer calyx than the material from Loei. Further collections are needed to see whether the Loei material differs taxonomically from *Microchirita hypocrateriformis*.

11. *Microchirita involucrata* (Craib) Yin Z. Wang, J. Syst. Evol. 49: 60 (2011); Rafidah, Gard. Bull. Singapore 69: 15 (2017). – *Chirita involucrata* Craib, Gard. Chron., Ser. 3, 83: 140 (1928); Barnett, Fl. Siam. 3: 223 (1962); Wood, Notes Roy. Bot. Gard.

Edinburgh 33: 199 (1974); Burt, Thai Forest Bull., Bot. 29: 88 (2001). – TYPE: Cult. Hort. Bot. Aberdeen from seeds collected by Kerr (*Kerr 11172*), Thailand, Kaw Tao [Surat Thani, Kao Tao], 30/12/1926 (lectotype ABD [specimen with appended protologue], designated by Puglisi in Rafidah (2017); isolectotypes ABD [2 sheets]). (Fig. 7)

Chirita involucellata Craib, Gard. Chron., Ser. 3, 83: 140 (1928). – TYPE: Cult. Hort. Bot. Aberd., 17/11/1927, from seeds collected by Kerr, Thailand, [Chumphon], Tako, 8/2/1927 (holotype ABD).

Notes. This species is easily recognisable from the inflorescence, which has two bracts that are not fused across the axis (compare to *Microchirita rupestris* where the bracts are fused together). The flower is narrowly funnel shaped, variously coloured in shades of purple, and the fruit is narrow, long and more or less curved. In Thailand three varieties can be distinguished.

Key to the varieties of *Microchirita involucrata*

- 1a. Bracts 16–45 mm long; corolla 18–21 mm long 2
- 1b. Bracts to 10 mm long; corolla c. 35 mm long
..... 11c. *M. involucrata* var. *gigantiflora*
- 2a. Anthers hairy 11a. *M. involucrata* var. *involucrata*
- 2b. Anthers glabrous 11b. *M. involucrata* var. *capitis*

11a. *Microchirita involucrata* var. *involucrata*

Lithophytic or terrestrial, succulent herb to 2 m tall. **Stem** fleshy, very sparsely hairy (mixed glandular and eglandular hairs), green or purple-reddish, especially around the nodes and the younger parts, branching, with internodes 1–7 cm. **Leaves** opposite, except for the single basal leaf; petioles 1.5–6 cm long, eglandular hairy; blades mid to dark green above, greenish white beneath, ovate or lanceolate, 4.1–11 × 2.6–6.8 cm, 1.2–1.9 times as long as wide, base shortly attenuate to rounded, often unequal, apex more or less broadly acute, eglandular tomentose above, much less so beneath, margin entire or obscurely denticulate, 5–8 pairs of secondary veins in the opposite leaves, venation slightly sunken above and raised beneath in fresh material, tertiary venation inconspicuous. **Inflorescences** arising from the petiole, close to the axil, consisting of a main pedunculate inflorescence, which can be more or less compound, and a bud at its base, axes light green; peduncles sparsely glandular and eglandular hairy, 2–35 mm long; bracts paired, free, sessile or shortly petiolate, petiole predominantly glandular hairy, lamina with mixed glandular and eglandular hairs above and beneath, entire to weakly serrate, ovate, 1.6–4.5 × 1.1–2.2 cm; pedicels sparsely hairy, mixed glandular and eglandular, predominantly glandular, 1–2.5 cm. **Calyx** light green to maroon,

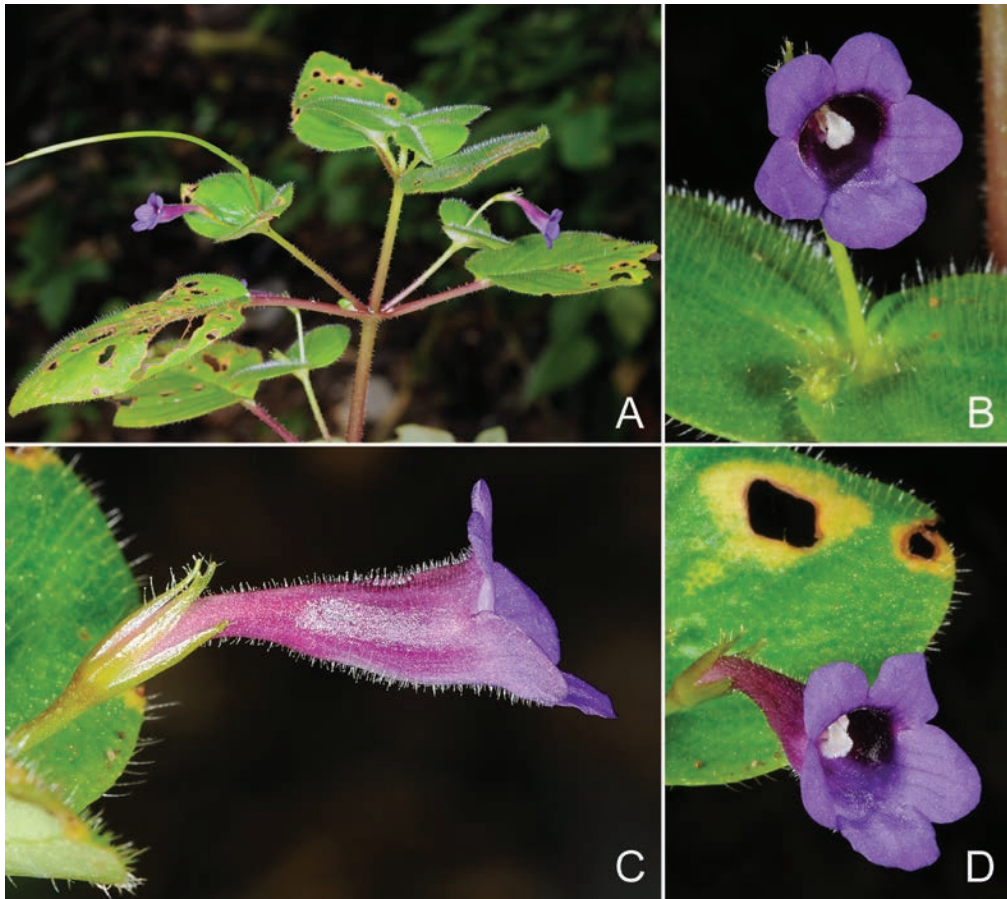


Fig. 7. *Microchirita involucrata* (Craib) Yin Z.Wang var. *involucrata*. **A.** Habit and fruit. **B.** Front view of the flower. **C.** Side view of the flower. **D.** Lateral view. All from Middleton, D.J. *et al.* 5391. (Photos: P. Karaket)

tube 0.5–3 mm long, lobes lanceolate, overlapping, $4\text{--}7 \times 0.7\text{--}1.4$ mm, apex acute, predominantly glandular hairy on the outer side, inside glabrescent or with sparse, fine glandular hairs. **Corolla** 18–21 mm long, bluish-violet, dark purple at mouth and dorsally by the anthers, with two purple stripes laterally along the filaments, lobes violet or light blue, flower occasionally reported to be much paler to off white especially at mouth, tube narrow at base, straight to bent, gradually broadening, glandular pubescent outside, especially dorsally between the upper lobes and ventrally below the central lobe, internally with sparse eglandular hairs on the upper lip and centrally in the lower lip, tube glabrous inside, lobes not reflexed; tube 12.5–16.5 mm long dorsally, 15–19.5 mm ventrally, 12.5–17 mm laterally between lips; upper lobes broadly elliptic, $2.3\text{--}4.5 \times 3.1\text{--}5$ mm, lateral lobes elliptic, $2.2\text{--}4.5 \times 2.6\text{--}7$ mm, lower lobe elliptic, $2\text{--}5 \times 2.9\text{--}9$ mm. **Stamens** arising 8–10 mm above the corolla base; filaments white to purple, bent twice, or almost straight, sometimes swollen in the middle, glabrous, 3.3–4.6 mm

long, 0.4–0.7 mm wide, with a small projection at the anther's insertion; anthers white, hairy dorsally and on the upper and lower surfaces, hairs sparse to abundant, $1.7\text{--}2.5 \times 1.3\text{--}1.9$ mm, apically weakly joined by a thin connective, free in old specimens, thecae slightly divergent, anthers whitish, apices slightly acuminate; lateral staminodes 0.7–3 mm long, to 0.1 mm wide, arising 8.5–10 mm above the corolla base, hairy at the tip, central staminode 0.3–0.7 mm long, arising 8–10 mm above the corolla base, often inconspicuous. **Disk** annular (some specimens appear to have a partial disk, probably due to breakage?), margin irregular to lobed, 0.2–0.6 mm high. **Pistil** 12–20 mm long; ovary 6.5–10 mm long, glabrous, many ovules; style green, 0.4–0.7 cm, glandular pubescent; stigma white, broadly bilobed, lobes 0.5–2.5 mm long, 0.4–0.7 mm wide, elliptic, often glandular hairy outside. **Fruit** light green, turning brown at maturity, to 10 cm long, glabrous or with persistent style hairs distally, straight or slightly curved. **Seeds** brown, broadly elliptic, c. 0.4×0.2 mm.

Distribution. Thailand. Vietnam, Cambodia, Malaysia.

Habitat. Lithophyte on different types of rocks, in shaded areas in evergreen forest.

Provisional IUCN conservation assessment. Least Concern LC. This variety is common and widespread.

Additional specimens examined. **Unknown locality:** Smith, E. 71 (BK); Cult. 11172 coll. 7/11/1929 (ABD [2 sheets]), Cultivated at RBGE from material grown at Botanische Anstalt University, Basel, acc. 801771, P12, C13666 (E); Cult Aberdeen “150”, no data (ABD), Cult Aberdeen “180” (ABD); Near Langkawi, 15 Jan 1916, Annandale, N. 1850 (SING); Kaw Koh Suwan near Langkawi, 14 Jan 1916, Annandale, N. 1833 (SING); Koh Si Kah, 17 Jan 1916, Annandale, N. 1589 (SING); Koh Si Kah, 17 Jan 1916, Annandale, N. 1590 (SING). THAILAND: **Ayutthaya:** s.l., 8 Jan 2496 [1953], Piyakarnchown, T. 11 (BK). **Chonburi:** Si Racha, Chan Ta Then Falls, 300–400 m, 17 Nov 1974 Maxwell, J.F. 74-988 (BK); Sattahip, Si Chon Tiam, Nong Nooch BG, 6 Sep 2004, Palee, P. 715 (CMUB); Sriracha, 14 Nov 1926, Put, N. 444 (ABD, BK, BM, K); Sriracha, Nong Nam Kheo, 240 m, 15 Nov 1926, Collins, D.J. 1277 (K); Hoop Bon, Sriracha forest, c. 400 ft, 25 Oct 1927, Collins, D.J. 1694 (K); Si Racha, Kow Kieo, 200 m, 20 Oct 1975, Maxwell, J.F. 75-1064 (E). **Chumphon:** 24 Mar 1971, Bogner 434 (E); Cultivated RBGE from Bogner 434, C8252 (E); Sawi, Khao Thalu, 31 Dec 1999, Wongprasert, T. 9912-04 (BKF); *ibid.*, 5 Dec 1999, Wongprasert, T. 9912-14 (SING); Lamae, Tham Khao Phu, 25 m, 7 Feb 2005, Williams, K. *et al.* 1259 (A, BKF, E); Mueang Chumphon, Wat Tham Khao Khun Krating, 70 m, 12 Jun 2006, Williams, K. *et al.* 1666 (A, BKF, E); Thun Tako, Ban Khao Talu, 4 Dec 2002, Koonkhunthod, N. *et al.* 308 (BKF); Sawi, Khao Thalu, 5 Dec 1999, Wongprasert, T. 9912-20 (BKF); Pa Thieo, Thale Sap, Wat Tham Thale Sap, 50 m, 17 Dec 2006, Pooma, R. *et al.* 6372 (BKF); Sawi, Khao Khai, Tham Thip Prida San Chang Len, 70 m, 26 Dec 2006, Pooma, R. *et al.* 6680 (A, BKF); Bang Son, 10 Sep 1927, Put 1042 (K); Bang Son, 10 Sep 1927, Put, N. 1035 (BM, K); Sapli, 9 Sep 1927, Put, N. 1021 (BK, BM, K); cultivated in Edinburgh from seeds from Bogner 424, Nov 1971, C8251-71-0977 (E [2 sheets]); Luang Suan, 23 Mar 1971, Bogner 424 (E); Kao Muang, c. 20 m, 11 Jan 1927, Kerr, A.F.G. 11368 (BK, BM, K). **Krabi:** Cultivated in Penang BG, flowered in Aug 1897, Kasoom, Nov 1896, Curtis 3221 (SING [2 sheets]); Khao Phra Bang Wildlife Reserve, 50 m, 5 Oct 1996,

Barfod, A. *et al.* 43828 (BKF, K); Tham Suea, 50–250 m, 24 Oct 1991, *Larsen*, K. *et al.* 42542 (BKF, P); Bang Kram Forest Reserve, 14 Jul 1992, *Larsen*, K. *et al.* 43405 (BKF); Khao Phra Bang Wildlife Reserve, Sa Morakote (Emerald pool), 75 m, 1 Oct 2005, *Maxwell*, J.F. 05-508 (A, BKF); Khao Panom Bencha National Park, Tham Phung, 250 m, 13 Oct 2002, *Palee*, P. 559 (CMUB). **Nakhon Ratchasima**: Lat Bua Kao, Oct 1916, *Kloss*, C.B. *s.n.* (K). **Nakhon Si Thammarat**: Lan Saka, Khao Luang National Park, Wat Khiriwong, 90 m, 31 Feb 1966, *Hansen*, B. & *Smitinand*, T. 12172 (BKF, SING); Lan Saka, Ka Rom Waterfall, 15 Dec 1972, *Santisuk*, T. & *Nimanong*, B. 293 (BKF, SING); Khiriwong, *Suvarnakoses*, P. 1809 (BKF); Thung Song, 28 Aug 1967, *Shimizu*, T. & *Nalampoon*, A. T-8255 (BKF); Thung Song, Ban Thi Wang, Wat Tham Phra Kru, 55 m, 11 Sep 2010, *Middleton*, D.J. *et al.* 5391 (BKF, E); Nopphitam, Tham Lot Cave, 80 m, 13 Feb 2005, *Williams*, K. *et al.* 1457 (A, BKF, E); Khao Luang National Park, 25 Oct 1991, *Larsen*, K. *et al.* 42581 (BKF); Si Chon, Si Chon Si Khit, Waterfall NP, 21 Dec 2006, *Pooma*, R. *et al.* 6526 (BKF, E); Khanom, Mu Ko Thale Tai National Park, Nam Tei Waterfall, 130 m, 18 Feb 2004, *Middleton*, D.J. *et al.* 3207 (A, BKF); Khiriwong, 31 Jan 1966, *Suthasorn*, S. 879 (BK); Lan Saka, Khao Luang National Park, Wat Khiriwong, 100–700 m, 17 Jan 1966, *Tagawa*, M. *et al.* T-4546 (BKF, E, K); Lan Saka, c. 100 m, 25 Apr 1928, *Kerr*, A.F.G. 15391 (ABD, BK, K, P); Cultivated in Aberdeen, 14 Nov 1928, from *Kerr* 15391 (ABD). **Narathiwat**: s.l., 100 m, 5 Feb 1961, *Smitinand*, T. 7119 (BKF, E, SING); Budo-Sungai Padi National Park, Pajo Falls, 250 m, 27 Dec 1999, *Wongprasert*, T. 9912-81 (BKF); Bacho, 20 Dec 1968, S.P. 16 (BKF, SING); Bacho, 15 Dec 1968, *Sangkhachand*, P. 1572 (BK). **Pattani**: Sai Khao Waterfall, 15 Nov 1968, *Smitinand*, T. *s.n.* (BKF); Sai Kao Waterfall, 100–150 m, 9 Oct 1991, *Larsen*, K. *et al.* 42247 (BKF); Sai Kao Waterfall, 50–200 m, 20 Dec 1972, *Santisuk*, T. & *Nimanong*, B. 446 (BKF, SING); Koke Po: Sai Khao Falls Forest Park, 24 Jan 1985, *Maxwell*, J.F. 85-100 (BKF). **Phang Nga**: Khao Lak National Park, 21 Nov 2004, *Chamchumroon*, V. 2116 (BKF, PSU); Mueang Phang Nga, Suan Somdet, 8 Dec 1999, *Wongprasert*, T. *s.n.* (BKF, SING); Mueang Phang Nga, Sri Nakharin Park, 18 Nov 2014, *Suddee*, S. *et al.* 4813 (BKF); Takua Pah, Khao Lak-Lam Ru National Park, 6 Nov 2014, *Suddee*, S. *et al.* 4789 (BKF). **Phatthalung**: Khao Chai Sohn, Pratudong Cave, 50 m, 12 Jan 1987, *Maxwell*, J.F. 87-23 (BKF, CMU); Khuan Khanum, Makok Nuea, Wat Phu Khao Thong, 30 m, 24 Dec 2006, *Pooma*, R. *et al.* 6615 (BKF, E); Ban Phot, 100–150 m, 20 Dec 1979, *Shimizu*, T. *et al.* T-27742 (BKF, L); Khao Chai Sohn, 30 m, 23 Dec 2006, *Pooma*, R. *et al.* 6580 (BKF, E); Kao Oktalu, c. 200 m, 21 Apr 1928, *Kerr*, A.F.G. 15349 (BK, K); Cultivated from *Kerr*, A.F.G. 15349, coll. 6/11/1928 (ABD [2 sheets]); Kao Hua Tek, 50 m, 2 May 1930, *Kerr*, A.F.G. 19454 (K); Khao Oktalu, 120 m, 21 Apr 1938, *Kerr*, A.F.G. 15776 (K). **Phetchaburi**: s.l., c. 10 m, 7 Nov 1926, *Kerr*, A.F.G. 11064 (ABD, BM, K); Cha Am, Khao Nang Phanthurat Forest Park, 50 m, 15 Dec 2006, *Pooma*, R. *et al.* 6322 (BKF, E). **Phuket**: Thalang, Khao Pateaw Wildlife Sanctuary, Ton Sai Waterfall, 13 Dec 1979, *Shimizu*, T. *et al.* T-27153 (BKF). **Prachuap Khiri Khan**: s.l., 27 Nov 1966, *Sangkhachand*, B. 1107 (E); Bangsaphan, Phong Prasat subdistrict, Khao Ma Rong cave, 2 Oct 2001, *Pooma*, R. *et al.* 3063 (BKF); Pran Buri, Khao Sam Roi Yot, 26 Oct 1973, *Suthasorn*, S. 2722 (BK); Hui Yang Fall, 6 Oct 1930, *Put*, N. 3234 (ABD [2 sheets], BM [2 sheets], BK, K [3 sheets]); Kui Buri, Khao Daeng, 22 Oct 1973, *Suthasorn*, S. 2676 (BK); Hui Yang Fall, 24 Oct 1964, *Chermisrivathana*, C. 175 (BK [2 sheets]); Kui Buri, Khao Daeng, 9 Nov 1964, *Adisai* 926 (BK); Pran Buri, Sam Roi Yot, Tum Pa Ya Na Khon, 30 Aug 2006, *Triboun*, P. 3640 (E); Khao Loom Muak, 200 m, 5 Sep 2008, *Middleton*, D.J. *et al.* 4277 (E). **Ranong**: Kra Buri, Phra Khayang Cave, 2 Nov 2007, *Pattharahirantricin*, N. 166 (BKF). **Ratchaburi**: Tham Chompol Arboretum, 24 Nov 1987, *Smitinand*, T. & *Santisuk*, T. *s.n.* (BKF); Cultivated in Bangkok from a plant collected in Ratchaburi, 14 Oct 1924, *Kerr*, A.F.G. 9321 (BM, K); Cultivated in Bangkok from plant

collected in Ratchaburi, 25 Oct 1924, *Kerr, A.F.G. 9341* (BM). **Satun:** Tarutao National Park, Adang Island, Oct 1979, *Congdon, G. 57* (E). **Songkhla:** s.l., 21 Dec 1978, *Hamilton & Congdon, G. 101* (BKF); 0–10 m, 8 Apr 1928, *Kerr, A.F.G. 15101* (BK, BM, K); Tam Ta Lord, 100 m, 25 Nov 1990, *Larsen, K. et al. 41711* (BKF); ibidem, 100 m, 25 Nov 1990, *Larsen, K. et al. 41714* (BKF, P); 10 km NE of Boriphath Falls, 28 Aug 1983, *Eddie, W.M.M. s.n.* (BKF); Rattapoom, Khao Rak Kiat, 50 m, 9 Dec 1986, *Maxwell, J.F. 86-1035* (BKF, CMU); Boriphath Falls National Park, 20 Dec 1984, *Maxwell, J.F. 84-538* (BKF); ibidem, 120–150 m, 18 Dec 1979, *Shimizu, T. et al. T-27611* (BKF, L); ibidem, 120–150 m, 18 Dec 1979, *Shimizu, T. et al. T-27591* (BKF, L); Boriphath waterfall, 9 Nov 1990, *Larsen, K. et al. 41239* (BKF); Rattaphum, 21 Dec 1965, *Youngboonkird, U. 263* (BK); Sabahoy, Bahoï, Ban Ranuea, 200 m, 1 Nov 1998, *Maknoi, C. 26* (QBG); Kao Changlan, c. 50 m, 24 Jul 1928, *Kerr, A.F.G. 15894* (BM, K). **Surat Thani:** s.l., 5 Dec 1975, *Phraphat, D. 103* (BKF); Tai Rom Yen National Park, 100 m, 18 Dec 2006, *Pooma, R. et al. 6409* (BKF, E); Tai Rom Yen National Park, Tham Khamin, 100 m, 18 Dec 2006, *Pooma, R. et al. 6419* (A, BKF); Viphavadee, Ta Kuk Tai, Viphavadee Waterfall, Ban Wan Phak Wan 16 Feb 2012, *Sirimongkol, S. et al. 290* (BKF); Ko Samui, Namuang Falls, 50 m, 4 Feb 1987, *Maxwell, J.F. 87-145* (BKF, CMU); Kaw Samui, c. 100 m, 10 Apr 1927, *Kerr, A.F.G. 12591* (BM, K); Kaw Samui, c. 100 m, 8 Apr 1927, *Kerr, A.F.G. s.n.* (BM); Koh Samui, 50–100 m, 3 Dec 1974, *Geesink, R., Hiepkö, P. & Phengklai, C. 7738* (L); Khao Sok, 26 Dec 1976, *Santisuk, T. 856* (BKF); Kaw Ngua Talam, 7 Apr 1927, *Kerr, A.F.G. 12935* (K); Kaw Tao, c. 30 m, 30 Dec 1926, *Kerr, A.F.G. 11172* (ABD, BM, K); Kaw Tao, c. 10 m, 14 Apr 1927, *Kerr, A.F.G. 11172A* (ABD, BM, K); Cult. from *Kerr, A.F.G. 11172* coll. 7/11/1929 (ABD [2 sheets]); Cult. from *Kerr, A.F.G. 11172* coll. 6/11/1928 (ABD [2 sheets]); Cult. from *Kerr, A.F.G. 11172* no coll. date (ABD [2 sheets]); Ban Kawp Kep, c. 100 m, 5 Aug 1927, *Kerr, A.F.G. 13179* (ABD, BK, BM, K); Ban Khan Thuli, 7 Sep 1931, *Put, N. 4130* (BM, K); Kau Hoa Kwai, Tassateng, 3 Jan 1935, *Seidenfaden 2134* (SING). **Trang:** Huay Yot, Wat Tham Iso, 130 m, 6 Mar 2006, *Middleton, D.J. et al. 4099* (A, BKF, E); ibidem, 101 m, 9 Sep 2008, *Middleton, D.J. et al. 4423* (BKF, E); Khao Pina, 16 Nov 1990, *Larsen, K. et al. 41475* (BKF); Na Yong, Na Muen Si, Wat Hua Khao, Santikhunakorn ladder, 60 m, 24 Dec 2006, *Pooma, R. et al. 6598* (BKF, E); Khao Pina, 150 m, 23 Oct 1991, *Larsen, K. et al. 42505* (BKF); Khao Chong, 5 Mar 1969, *Sangkhaachand, P. 1758* (BK). **Yala:** s.l., 31 Jan 1931, *Put, N. 3685* (ABD [2 sheets], BM, K); Wat Tam, 50 m, 10 Dec 1972, *Santisuk, T. & Nimanong, B. 367* (BKF (3), SING); Than To, Bang Lang National Park, 80 m, 8 Feb 2004, *Middleton, D.J. et al. 2784* (A, BKF); Bannang Sata, Khuean Bang Lang, Ban Santi, 150 m, 28 Oct 2005, *Poopath, M. 403* (BKF, E); Bannang Sata, Khuean Bang Lang, Ban Santi, 150 m, 1 Sep 2005, *Poopath, M. 350* (BKF, E); Than To, Bang Lang National Park, 200 m, 8 Dec 2004, *Palee, P. 681* (A, E).

11b. *Microchirita involucrata* var. *capitis* (Craib) C.Puglisi, **stat. nov.** – *Chirita capitis* Craib, Bull. Misc. Inform. Kew 173 (1930); Barnett, Fl. Siam. 3: 223 (1962). – TYPE: “Described from plants raised in Aberdeen from seed collected in Bangkok by Dr. A.F.G. Kerr. Flowered in November 1928”, the specimen is labelled Kerr “179”, collected on 6/11/1928, cultivated in Aberdeen from Bangkok seed (lectotype ABD, designated by Wood (1974: 199); isolectotype K [K000545592]).

Distribution. Central and Southwestern Thailand.

Habitat. On rocks and walls.

Provisional IUCN conservation assessment. Data Deficient DD. The known EOO and AOO for this variety would qualify it as Endangered if there were associated threats. However, most of the collections are old and distributions from the areas in Central Thailand cannot be verified.

Additional specimens examined. **Unknown locality:** Cult Aberdeen, 9 Nov 1929, *Kerr, A.F.G.* “241” (ABD [2 sheets]). THAILAND: **Ayutthaya:** s.l., 21 Dec 1936, *Kerr, A.F.G.* 19891 (BK, BM, K). **Bangkok:** under 5 m, 3 Jan 1923, *Kerr, A.F.G.* 6717 (ABD, K, BM); 29 Nov 1925, *Kerr, A.F.G. s.n.* (ABD, BK, BM, K); 16 Oct 1919, *Kerr, A.F.G.* 3820 (ABD, BM, K); 9 Oct 1920, *Kerr, A.F.G.* 3820A (ABD, BM, K); 5 Dec 1920, *Marcan, A.* 482 (BM, K); Wat Jum, 6 Oct 1921, *Kerr, A.F.G. s.n.* (BM). **Lop Buri:** Ayuthia, 22 Oct 1926, *Smith, H.M. s.n.* (BM). **Prachuap Khiri Khan:** Khao Sam Roi Yot National Park, 3 Dec 1928, *Put, N.* 2521 (K); Pran Buri, Sam Roi Yot, 7 May 1974, *Larsen, K. & Larsen, S.S.* 33698 (AAU).

Notes. This variety was first described by Craib (1930) as a species but was included in synonymy of *Microchirita involucrata* by Wood (1974). It is here reinstated at the rank of variety. The only distinguishing feature is the lack of an indumentum on the anthers. Given the otherwise identical morphology and the overlapping distribution, a varietal status is preferred for this taxon.

11c. *Microchirita involucrata* var. *gigantiflora* C.Puglisi, var. nov.

This variety differs from *Microchirita involucrata* var. *involucrata* in the longer flower (c. 35 mm vs. c. 20 mm) and the much smaller bracts (< 1 cm long in var. *gigantiflora*, ≥ 1.6 cm in var. *involucrata*). – TYPE: Thailand, Nakhon Si Thammarat, Kha Nom, Khuan Thong, Khao Wang Thong Cave, 50 m, 20 December 2006, *Pooma, R., Phattarahirankanok, K. & Sirimongkol, S.* 6472 (holotype BKF; isotype E [E00311111]).

Distribution. Peninsular Thailand (Nakhon Si Thammarat).

Habitat. On limestone in evergreen forest.

Provisional IUCN conservation assessment. Data Deficient DD. This variety is only known from the type collection and its distribution and potential threats to it are unknown.

Notes. The floral characters match *Microchirita involucrata* var. *involucrata*, including key features such as the glabrous ovary and the loosely coherent anthers, except that the corolla parts are proportionately larger.

12. *Microchirita karaketii* D.J.Middleton & Triboun, Thai Forest Bull., Bot. 41: 17 (2013). – TYPE: Thailand, Chiang Mai, Chiang Dao District, Doi Chiang Dao Wildlife Sanctuary, Tam Pak Piang, 530 m alt., 20 September 2008, *Middleton, D.J.*,

Karaket, P., Triboun, P., Kawatkul, U. & Meeboonya, R. 4526 (holotype BKF; isotypes E [E00629480], P [P00966764], QBG). (Fig. 8)

Herb to 60 cm tall with elongated stem runners. Habit caulescent, internodes c. 8 cm (only one seen). **Stems** succulent, green, sometimes tinged with reddish, glabrous or glabrescent; branches sometimes arising from the petioles. **Leaves** opposite, apart from the basal leaf; petioles 0.5–2 cm long, green, sparsely eglandular hispid; blades mid to dark green above, whitish green beneath, ovate, 5.1–25 × 3.5–19 cm, 1.6–2.6 times as long as wide, base cordate, apex acuminate, sparsely eglandular hairy above and beneath, ciliate along the margin, margin entire, 7–15 pairs of secondary veins, steeply ascending, venation sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation laxly reticulate. **Inflorescences** cristate, peduncles reduced or emerging to 10 mm long and sometimes fused together; bracts absent; pedicels pale green, 4.5–10 mm long, glabrescent or very sparsely hairy. **Calyx** green, bilabiate, lower lobes completely divided, upper lobes joined for 1–5 mm, lobes narrowly lanceolate, 1–6 × 0.8–1.6 mm, apex acuminate and slightly thickened, margin entire, sparsely hairy especially at the tip. **Corolla** 12–18 mm long, white with a yellow stripe ventrally inside and violet patches at its sides, lobes white, tube narrow, curved, progressively widening, upper lobes spreading, eglandular hairy outside, glabrous inside; tube 9–13 mm long dorsally, 9.3–14 mm ventrally, 7.8–14 mm laterally between lips; lobes broadly orbicular to elliptic, apices rounded, upper lobes 2.7–3.5 × 2.8–4.7 mm, lateral lobes 2.8–5 × 4–5.8 mm, ventral lobe 3–4.7 × 3.8–5.5 mm. **Stamens** arising 3.3–6.5 mm above the corolla base, filaments straight, glabrous, 2.8–3.5 mm long, c. 0.3 mm wide; anthers white or pale yellow, with a sparse long indumentum by the insertion, 1.4–2 × 0.8–1.2 mm, apically joined by a connective, thecae divergent; staminodes arising c. 3 mm above corolla base, c. 0.3 mm long. **Disk** absent or a ventral half ring 0.6–0.7 mm high. **Pistil** c. 15 mm long; ovary 3.5–5 mm long, c. 1 mm diameter, papillose or with sparse hairs in the top half; style 6–7 mm long, pubescent; stigma chiritoid, c. 1.2 mm long. Immature **fruit** green, to 5 cm long, c. 1.5 mm diameter, glabrous, straight or slightly curved. **Seeds** brown, narrowly elliptic, acuminate, 0.4–0.5 × c. 0.2 mm.

Distribution. Northern Thailand. Myanmar.

Habitat. On limestone in mixed deciduous forest.

Provisional IUCN conservation assessment. Vulnerable VU B1ab(iii). The EOO is around 8,000 km², it is known only from fewer than 10 populations, and some of the known localities are not in protected areas and subject to disturbance. The assessment will have to be reviewed once the distribution in Myanmar is better known.

Additional specimens examined. THAILAND: **Chiang Mai:** Chiang Dao, road to Wiang Haeng, 610 m, 21 Sep 2008, *Middleton, D.J. et al. 4536* (BKF, E); Chiang Dao, Daan Pha Woak, 740 m, 20 Aug 1999, *Watthana, S. et al. 559* (QBG); Chiang Dao, Kio Phawok border

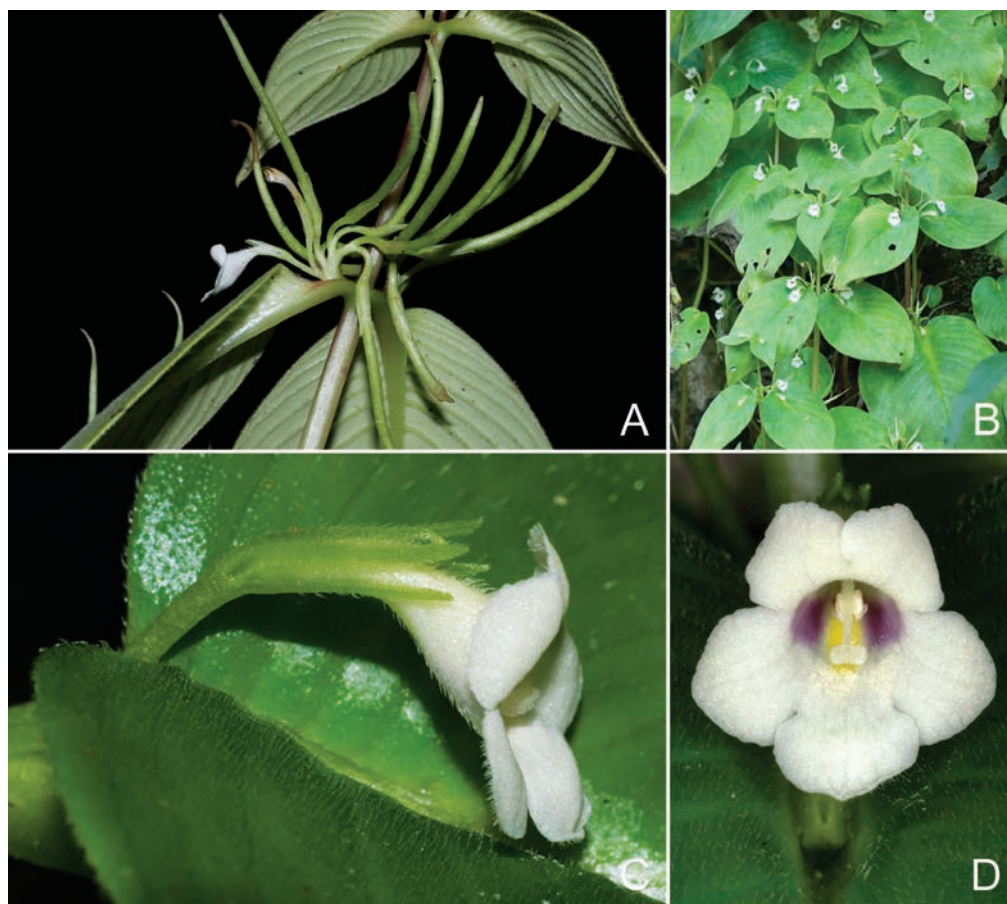


Fig. 8. *Microchirita karaketii* D.J.Middleton & Triboun. **A.** Fruit. **B.** Habit. **C.** Side view of the flower. **D.** Front view of the flower. A, C, D from *Middleton, D.J. et al. 4526*; B from *Middleton, D.J. et al. 4536*. (Photos: A–C, D.J. Middleton; D, P. Karaket)

checkpoint, 750 m, 30 Sep 2009, *Middleton, D.J. et al. 5017* (E). **Mae Hong Son:** Phang Mapha, Viewpoint, 867 m, 12 Sep 2013, *Lakoet, C. 400* (QBG).

Notes. The description provided is a slightly updated version of the original description by Middleton & Triboun (2013). *Microchirita karaketii* is recognisable from its colour pattern (white corolla, with a ventral yellow line and lateral violet markings). Other species with a similar colour pattern are *Microchirita huppatatensis* and *M. tubulosa*, which, however, differ greatly in the shape of the corolla and the anther indumentum. *Microchirita karaketii* is otherwise remarkably similar to *M. bimaculata*, which is bright yellow with dark brownish markings. Although the two species are sympatric in northern Thailand, no intermediate colour forms have been observed. *Microchirita karaketii* has flowers smaller than *M. bimaculata*, and its dry leaves do not acquire the yellowish hue observed in *M. bimaculata*.

13. *Microchirita lilacina* C.Puglisi, Kew Bull. 71(1)-2: 5 (2016). – TYPE: Thailand, Tak, Umphang, 504 m, 15 October 2014, *Middleton, D.J., Hemrat, C., Karaket, P., Puglisi, C. & Suddee, S.* 5704 (holotype BKF; isotypes AAU, E [E00663028], K, QBG, SING). (Fig. 9)

Herb to 40 cm tall. **Stems** fleshy, red at base, otherwise green, with pale green hairs, which are lost in dried specimens. **Leaves** opposite, with the exception of the single one or two basal leaves, fleshy (very thin when dry); petioles 0.3–2.5 cm long, glabrous; blades pale to mid green above, paler beneath, ovate, 2.5–18 × 1.4–13 cm, 1.3–1.8 times as long as wide, base cordate, apex acuminate or rarely acute, densely tomentose above, sparsely so beneath, margin entire, 6–10 pairs of secondary veins in the opposite leaves, 10–15 in the basal leaf, venation raised beneath in fresh material, tertiary venation finely and irregularly reticulate, visible only beneath. **Inflorescence** epiphyllous, 2–15-flowered, cristate; peduncles reduced or shortly emerging and fused together; bracts absent; pedicels green, 0.2–1.5 cm long, glabrous or sparsely hairy. **Calyx** pale green, bilabiate, tube 0.5–1.5 mm long, lobes narrowly lanceolate, 6.5–7 × 0.8–1.2 mm, with the central upper lobe (alternate to the upper corolla lobes) c. 1 mm shorter than the other lobes, membranous along the margins, apex narrowly obtuse, outside with scattered eglandular hairs along the midrib, inside with a minute indumentum of sessile glands. **Corolla** 8–12 mm long, markedly variable even within populations, tube whitish pale lilac, with a yellow stripe ventrally, lobes very pale lilac, tube with a narrow basal portion 3–4 mm long, c. 2.5 mm diam., then abruptly broadening into a campanulate tube, pubescent with very fine eglandular hairs outside except at base, inside glabrous, the upper lobes with sparse stalked glands, especially abundant towards the centre of the upper lip, the lower minutely papillose; tube 11–13 mm long dorsally, 13–14 mm ventrally, 10.5–12.5 mm laterally between lips, upper lobes elliptic, 3–3.5 × c. 5 mm, lower lateral lobes elliptic, 3–3.5 × 5–6.5 mm, lower central lobe rounded, 4–4.5 × 4.5–5 mm. **Stamens** arising 4.5–5 mm above the corolla base, filaments glabrous, 3.5–4.5 mm long, slightly twisted; anthers cream-white with a dark spot beside the attachment of the filament, glabrous, 1.7–3 × 0.6–1.5 mm, apically joined by a connective, thecae divergent and apiculate; lateral staminodes 1.5–3 mm long, arising 3–3.7 mm above the corolla base, central staminode c. 1.7 mm long, arising c. 2.8 mm above corolla base. **Disk** a ventral lobe, 0.3–0.4 mm high, with irregular margin. **Pistil** 12–16 mm long; ovary 6–11 mm long, with scattered glands for 1/2–2/3 and then distally with fewer glands and a dense eglandular pubescence; style 5–6 mm long, curved downwards, hairy as the upper part of the ovary; stigma with pronounced lobes, lobes 1–1.4 mm long, 0.6–0.8 mm wide, narrowly elliptic, glabrous outside, papillose inside. **Fruit** green, 2–6 cm long, 0.8–1 mm diam., glabrous at the base, sometimes with indumentum terminally, straight or curved. **Seeds** brown, elliptic, 0.4–0.5 × c. 0.2 mm.

Distribution. Southwestern and Northern Thailand (Kanchanaburi, Tak).

Habitat. On limestone.

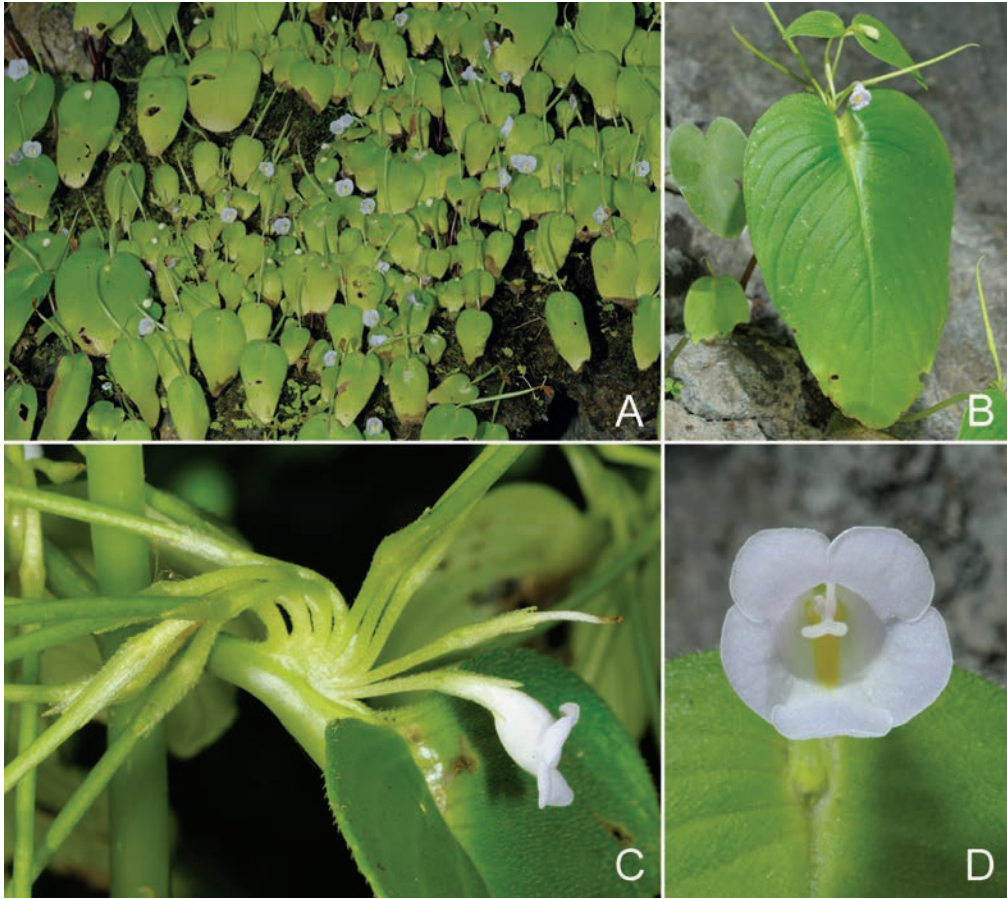


Fig. 9. *Microchirita lilacina* C.Puglisi. **A.** Unifoliate habit. **B.** Caulescent habit. **C.** Cristate inflorescence, fruit and side view of the flower. **D.** Front view of the flower. A from Middleton, D.J. et al. 5704; B–D from Middleton, D.J. et al. 5699. (Photos: P. Karaket)

Provisional IUCN conservation assessment. Vulnerable VU B1ab(iii). Puglisi et al. (2016) assessed this species as Endangered but since that publication several new localities have been discovered which have expanded the EOO to around <20,000 km². This new assessment recognises that the threats to the habitat of the species still exist but that its wider distribution reduces the overall threat.

Additional specimens examined. THAILAND: **Kanchanaburi:** Sangkhla Buri, Tham Sukho, 180 m, 17 Dec 2009, *Pooma, R. et al.* 7433 (BKF); Sangkhla Buri, c. 120 m, 29 Aug 1999, *Chayamarit, K. et al.* 1831 (BKF [2 sheets]). **Mae Hong Son:** Muang Mae Hong Son, Mae Surin National Park, 840 m, 21 Oct 2014, *Middleton, D.J. et al.* 5820 (E, SING). **Tak:** Umphang, Pha Phueang, 990 m, 8 Oct 2014, *Suddee, S. et al.* 4759 (BKF); Umphang, Doi Hua Mot, *Suddee, S. et al.* 3312 (BKF); Umphang, Umphang-Maesot road, 500 m, 19 Oct 2013, *Pooma, R. et al.* 7894 (BKF); Umphang Wildlife Sanctuary, Doi Hua Mot area, 900 m, 18 Oct 2013, *Pooma,*

R. et al. 7886 (BKF, E); Umphang-Maesod road, 500 m, 24 Apr 2004, *Pooma, R. et al.* 4643 (BKF); Umphang, Ban Wa Khrue Kho, 543 m, 15 Oct 2014, *Middleton, D.J. et al.* 5699 (AAU, BKF, E, K, QBG, SING); Umphang, Doi Hua Mot Wildlife Sanctuary, 915 m, 17 Oct 2014, *Middleton, D.J. et al.* 5763 (AAU, E, K, QBG, SING); Tah Song Yang District, Tham Usu, 500 m, 10 Sep 2009, *Middleton, D.J. & Triboun, P.* 4842 (BKF, E, P).

Note. This species is recognisable by the pale lilac corolla and the glabrous anthers.

14. *Microchirita limbata* C.Puglisi, **sp. nov.**

Species characterised by the tubular corolla with white tube and blue lobes, and by the widespread glandular indumentum. It is most similar to *Microchirita albocyanea* C.Puglisi in the overall shape and colour of the corolla, but differs in the smaller flowers and in having a glandular indumentum. – TYPE: Thailand, Chaiyaphum, Khon San, Wat Tham Huang Po, 443 m, 19 October 2015, *Suddee, S., Keiwbang, W., Hemrat, C.* 4968 (holotype BKF; isotype SING). (Fig. 10)

Herb to 80 cm tall. Habit caulescent, internodes 1–10 cm. **Stems** succulent, glandular hairy; branches sometimes arising from the petiole of the basal leaf. **Leaves** opposite, apart from the basal leaf; petioles 0.2–1.7 cm long, glandular hairy; blades mid green above, much paler beneath, lanceolate to elliptic, 3.1–13 × 0.6–5.2 cm, 1.6–5.2 times as long as wide, base shortly attenuate to acute, apex acute to acuminate, eglandular pubescent above and beneath, ciliate along the margin with glandular and eglandular hairs, margin entire or obscurely denticulate, 4–14 pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation seldom visible in dry specimens. **Inflorescences** cristate, 1–7(–12)-flowered; peduncles reduced or 1–7 mm long, fused with each other, glandular pubescent; bracts absent; pedicels pale green to green, 0.2–1.2 cm long, glandular pubescent. **Calyx** pale green, succulent at the base, tube c. 0.3 mm long, lobes lanceolate, 4.5–8 × 0.7–1.5 mm, apex acuminate and thickened, margin entire, with mixed glandular and eglandular hairs on both sides, sparse inside, margin ciliate. **Corolla** 14–16 mm, tube white, throat white with a yellow patch at the base of the filaments, lobes purple-blue, tube narrow at the base, then becoming campanulate, only slightly curved, lobes almost equal, eglandular hairy outside except at base, densely glandular inside; tube 11–12.5 mm long dorsally, 11–12 mm ventrally, 11.5–13.5 mm laterally between lips; lobes obtuse (broadly elliptic becoming triangular with a broad apex) with irregular margin, upper lobes 2–3 × 3.7–4.8 mm, lateral lobes 2.5–4 × 3.5–6.5 mm, ventral lobe 3.5–4 × 2.7–7 mm. **Stamens** arising 4–5 mm above the corolla base, filaments geniculate near the base, green-yellow, glabrous, 2–3 mm long, 0.3–0.4 mm wide; anthers white, with white to brown hairs throughout except for the apices, 1.9–2.5 × 2.5–2.6 mm, apically coherent but not joined by a connective, or at most with a very weak and short ligature, thecae parallel or slightly divergent; lateral staminodes 0.3–0.9 mm long, arising 3–3.8 mm above the corolla base, central staminode 0.2–0.3 mm long, arising 3–3.6 mm above the corolla base. **Disk** annular, margin irregular,

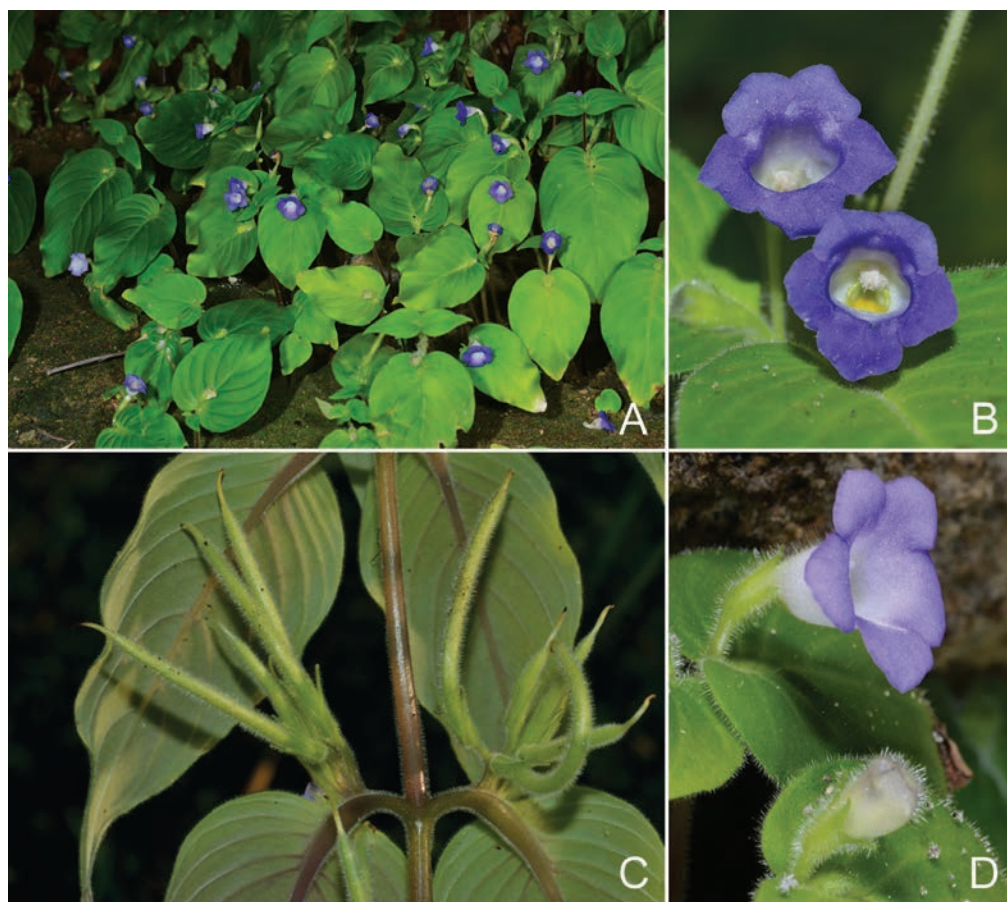


Fig. 10. *Microchirita limbata* C. Puglisi. **A.** Habit. **B.** Front view of the flower. **C.** Fruits. **D.** Lateral view of the flower. A, D from Tetsana, N. *et al.* 883; B, C from Suddee, S. *et al.* 4968. (Photos: A, D, N. Tetsana; B, C, S. Suddee)

0.1–0.2 mm high. **Pistil** c. 10.5 mm long; ovary 3.5–5 mm long, c. 1.1 mm diameter, glabrous at the base, then densely tomentose with glandular and eglandular hairs; style and stigma with the same indumentum observed on the ovary; style c. 4.5–5.5 mm; stigma bilobed, lobes elliptic, 0.5–1 mm. **Fruit** green, 1–4.5 cm long, 0.7–1.2 mm diameter, densely glandular hairy, straight or curved. **Seeds** brown, narrowly elliptic, mucronate, $0.3\text{--}0.4 \times 0.1\text{--}0.2$ mm.

Distribution. Northeastern and Eastern Thailand.

Habitat. On limestone in mixed deciduous forest.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii) + B2ab(iii). The EOO and AOO are within the threshold for the Endangered status and not all of

the localities are in protected areas with the associated threats to limestone habitats that entails.

Additional specimens examined. THAILAND: **Khon Kaen:** Sum Pak Nam, Phu Pha Man National Park, Chum Phae, 377 m, 21 Oct 2007, *Norsangsri, M. & Lakoet, C.* 2789 (E, QBG); Chum Phae, Phu Pha Man National Park, Tham Phaphung section, 25 Oct 2007, *Norsangsri, M. & Lakoet, C.* 2811 (QBG). **Loei:** Phu Kra Dueng, 504 m, 6 Nov 2014, *Tetsana, N. et al.* 883 (BKF, SING); Phukradung National Park, Sohme Krae area, 1000 m, 4 Oct 2003, *Palee, P.* 636 (CMUB).

Notes. The epithet refers to the contrast between the colour of the corolla tube and the lobes. The specimens from Khon Kaen have denser inflorescences (up to 12 flowers) and a denser indumentum, but are otherwise alike.

15. *Microchirita luteola* C.Puglisi, sp. nov.

Similar to *Microchirita tubulosa* (Craib) A.Weber & D.J.Middleton but differs in not having spots inside the lateral corolla lobes, having an entire disk (usually dorsally cleft in *M. tubulosa*), glandular indumentum on the stems (vs. eglandular), and acuminate calyx lobes (vs. usually acute, more rarely slightly acuminate). It is also similar to *Microchirita marcanii* in the shape of the corolla, but differs in the mixed eglandular and glandular indumentum on many plant parts (eglandular only in *M. marcanii* (Craib) A.Weber & D.J.Middleton) and the corolla colour pattern (light yellow corolla with a yellow stripe vs. orange corolla with lateral purple spots). Finally, it differs from *Microchirita elphinstonia* (Craib) A.Weber & D.J.Middleton in having a glandular indumentum and in the larger and much paler yellow corolla. – TYPE: Loei, Nong Hin, Suan Sa Wan, Pha Ngam Forest Park, 662 m, 11 September 2014, *Tetsana, N. et al.* 829 (holotype BKF; isotype SING). (Fig. 11A–C)

Caulescent herb to 50 cm tall, internodes 2.5–10 cm. **Stems**, petioles, pedicels and peduncles succulent, green and often tinged with reddish-brown, glandular and eglandular hispid; branches sometimes arising from the petioles of the basal leaf as well as the opposite leaves. **Leaves** opposite, apart from the basal leaf; petioles 0.1–1.5 cm long; blades pale to mid green above, whitish green beneath, ovate, elliptic or obovate, 3.8–8 × 1.5–5.8 cm, 1.2–3.1 times as long as wide, base shortly attenuate to cordate, apex acute to acuminate, eglandular strigose above, hispid beneath, ciliate along the margin with eglandular hairs, margin entire or obscurely denticulate, 7–17+ (leaf incomplete) pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation visible in dry specimens. **Inflorescences** cristate, 1–4-flowered; peduncles 4–10 mm long, shortly fused with each other; bracts absent; pedicels pale green to reddish brown, 3–25 mm long. **Calyx** reddish brown at the base, green apically, succulent at the base, tube c. 1.6 mm long, lobes imbricate at base, lanceolate, 14–17 × 3–3.5 mm, apex acuminate, margin entire, outside with short, patent, mixed glandular and eglandular

hairs, inside glabrous except at the tip, margin ciliate at the tip. **Corolla** c. 35 mm long, tube white at the base, turning pale yellow distally, base of ventral lobe with a yellow stripe, lobes pale yellow at the base, paler towards the margin, tube narrow at the base, curved basally and gradually broadening, mouth broad and slightly gibbous laterally and ventrally, base of the tube, upper lobes and ventral lobe glabrous, the rest of the corolla externally covered in short mixed glandular and eglandular hairs, internally with sparse glandular hairs, forming a denser patch at the base of the upper lobes, lobes slightly papillose; tube c. 23 mm long dorsally, c. 27.5 mm ventrally, c. 24 mm laterally between lips; lobes broadly elliptic, upper lobes c. 5.5×10 mm, lateral lobes c. 6×8.5 mm, ventral lobe c. 8.5×10.5 mm. **Stamens** arising c. 17 mm above the corolla base, filaments strongly geniculate, with a basal, thinner segment c. 2×0.7 mm, and an apical, thicker segment c. 4.5×1.6 mm, pale yellow, glabrous; anthers white, with white hairs dorsally, c. 3.5×2.5 mm, apically joined by a connective, thecae parallel or slightly divergent; lateral staminodes c. 0.7 mm long, arising c. 9 mm above the corolla base, central staminode c. 0.5 mm long, arising c. 9 mm above the corolla base. **Disk** annular, margin entire, 1 mm high, c. 0.5 mm thick (exceptionally thick). **Pistil** c. 29 mm long; ovary c. 10 mm long, c. 1.6 mm diameter, lower 1/3 glabrous, then densely tomentose with eglandular and perhaps glandular hairs; style c. 18 mm long, with the same indumentum as ovary; stigma bilobed, lobes elliptic, 1 mm. **Fruit** green, 7–10.5 cm long, 0.5–2.5 mm diameter, densely hairy, straight or slightly curved. **Seeds** light brown, narrowly elliptic, with irregular surface, 0.3×0.1 mm.

Distribution. Northeastern Thailand.

Habitat. On limestone in evergreen forest.

Provisional IUCN conservation assessment. Endangered EN B2ab(iii). This species has an AOO of around 20 km² and is only known from a small number of collections, not all of which are in protected areas.

Additional specimens examined. THAILAND: **Kalasin:** Somdat, Pu Parn, 24 Oct 1975, Sutharson, S. & Sangkhachand, P. 3450 (BKF). **Loei:** Nong Hin, Ban Puen Phue, c. 640 m, 22 Sep 2007, Thitimetharoch, T. et al. 797 (BKF); Phu Luang, 22 Aug 1966, Phusomsaeng, S. & Bunchuai, K. 11 (BKF, K, L); Phu Krading, Sam Khae, c. 1050 m, 16 Oct 1954, Smitinand, T. 2026 (BKF).

Notes. This species is named after its pale yellow corolla.

16. *Microchirita marcanii* (Craib) A. Weber & D.J. Middleton, Taxon 60: 778 (2011). – *Chirita marcanii* Craib, Bull. Misc. Inform. Kew 171 (1926); Barnett, Fl. Siam. 3: 226 (1962); Wood, Notes Roy. Bot. Gard. Edinburgh 33: 193 (1974); Burt, Thai Forest Bull., Bot. 29: 88 (2001). – TYPE: Thailand, Saraburi, Muak Lek, c. 250 m, 10 November 1924, Marcan 1872 (lectotype ABD, designated by Wood (1974: 193); isolectotypes K (2)). (Fig. 11D–F)

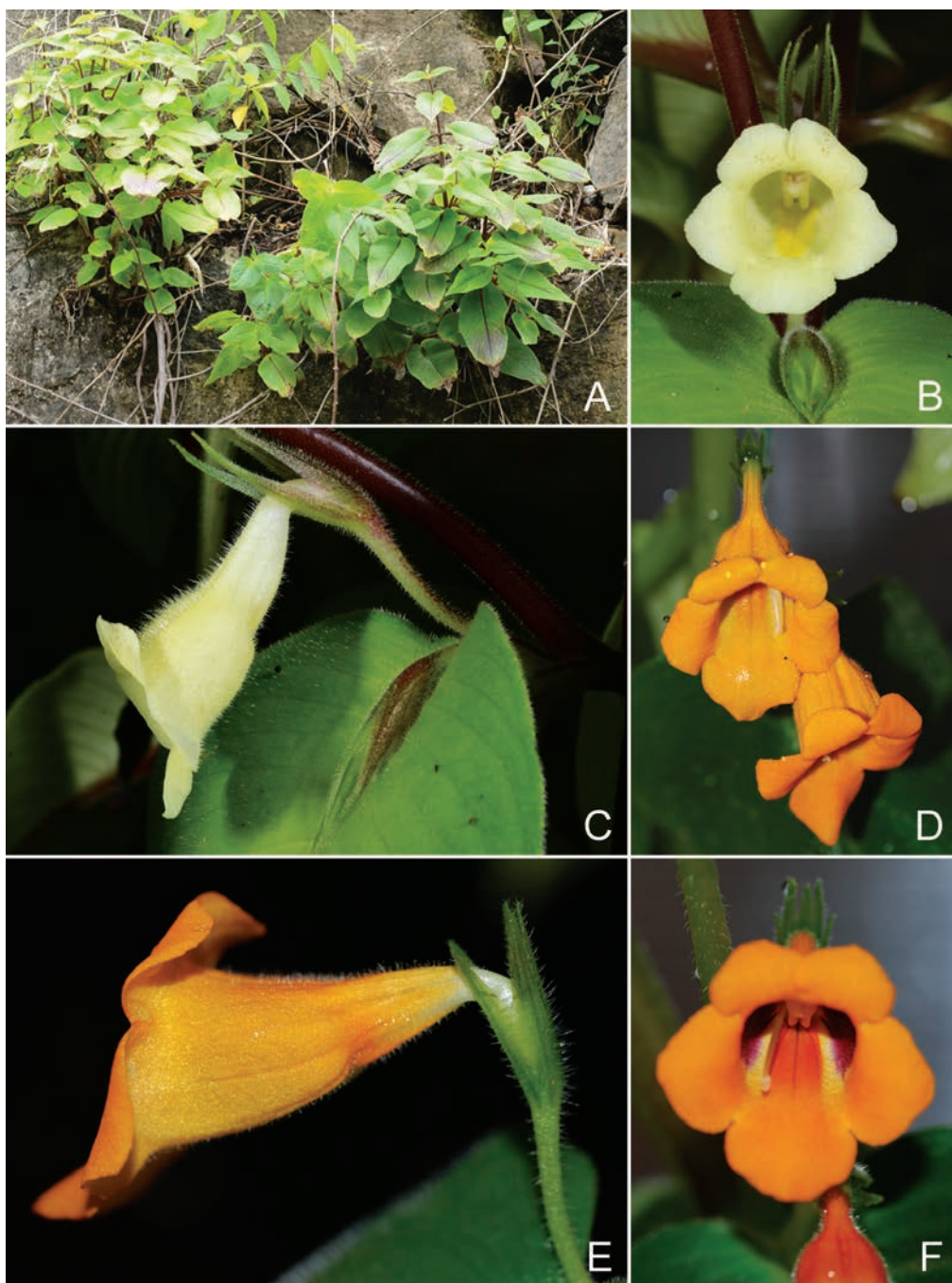


Fig. 11. *Microchirita luteola* C.Puglisi. **A.** Habit. **B.** Front view of the flower. **C.** Side view of the flower. All from Tetsana, N. et al. 829. *Microchirita marcanii* (Craib) A.Weber & D.J.Middleton. **D.** Flowers. **E.** Side view of the flower. **F.** Front view of the flower. All from RBG Edinburgh accession number 20121420. (Photos: A–C, N. Tetsana; D–F, D.J. Middleton)

Caulescent herb to 60 cm tall, internodes 4–13 cm long, branches sometimes arising from the petiole of the basal cotyledon. **Stem** fleshy, pale green with purplish base, sparsely eglandular hairy. **Leaves** opposite, apart from the basal leaf; petioles pale green, 7–14 mm long; blades mid green above, paler beneath, ovate, $6.2\text{--}24 \times 3.2\text{--}12.6$ cm, 1.7–2 times as long as wide, base cordate, apex acute to obtuse, eglandular hairy above and beneath, margin ciliate, margin entire to obscurely toothed, 8–15 pairs of secondary veins, venation sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation laxly reticulate. **Inflorescences** cristate, 10–16-flowered, all floral axes sparsely to densely eglandular hairy; peduncles 2–13 mm long, shortly fused with each other; bracts absent, except for first inflorescence arising from the petiole of each leaf, observed only in cultivated material; pedicels pale green to reddish brown, 3–26 mm long. **Calyx** actinomorphic, green, lobes succulent along the midrib, tube 1.3–3 mm, lobes imbricate, narrowly ovate, $7\text{--}18 \times 2.9\text{--}3.6$ mm, apex acute, margin entire, outside with eglandular hairs along the midrib, tip and margin, inside with sessile glands. **Corolla** 32–45 mm long, tube pale green at the base, then becoming dark orange, throat dark red with lateral purple spots, tube narrow at base, curved, then becoming broad, upper and lateral lobes spreading, tube glabrous at the base, then with mixed glandular (especially ventrally) and eglandular (especially dorsally) hairs, lobes papillose inside, the rest of the inside of the corolla glabrescent or sparsely glandular; tube 26–30 mm long dorsally, 29–32 mm ventrally, 22–27 mm between the lips; lobes with broadly obtuse apex and a minutely crenate margin, upper lobes $6\text{--}6.5 \times 10$ mm, lateral lobes $8 \times 12\text{--}13$ mm, ventral lobe $10\text{--}11 \times 12$ mm. **Stamens** arising 1.6–1.9 cm above the corolla base (the point where the corolla broadens), filaments slightly to strongly geniculate, $4.5\text{--}7 \times 1$ mm, pale yellow, glabrous, anthers white, hairy dorsally, $3\text{--}3.5 \times 1.5\text{--}2.7$ mm, apically joined by a connective, thecae divergent; lateral staminodes 0.5–2 mm long, arising 0.8–1.25 cm above the corolla base, central staminode 0.3–1 mm long, arising 0.9–1.35 cm above the corolla base. **Disk** annular, margin slightly lobed, 0.8–1 mm high. **Pistil** 27 mm long; ovary c. 1 cm long, 1.7 mm diameter, glabrous in the bottom $1/3\text{--}1/2$, densely hairy above; style slender, 1–2 cm long, hairy; stigma bilobed, lobes c. 0.9–1 mm, papillose/plumose. **Fruit** green, 4.5–6.2 cm long, 3.5–4 mm diameter, glabrous at the base, eglandular hairy apically, slightly curved. **Seeds** very dark brown, oval, $0.7\text{--}0.8 \times 0.2\text{--}0.4$ mm.

Distribution. Central and Eastern Thailand.

Habitat. On limestone.

Provisional IUCN conservation assessment. Vulnerable VU B1ab(iii) + B2ab(iii). This species has an EOO and an AOO within the threshold to be considered endangered but is known from 5–10 localities, thereby making the Vulnerable status more appropriate.

Additional specimens seen. **Unknown province:** 22 Oct. 1929, *Kerr*, A.F.G. (ABD); no label data (ABD); Cult. Hort. Bot. Reg. Kew., Nov 1926 “Bot. Mag. t. 9244” (K [2 sheets]); Cult. Hort. Bot. Reg. Kew. A.D. 196? (K); Cultivated, doubtfully from Mueang Ngao, Lampang,

Kerr A.F.G. 20571 (ABD). THAILAND: **Nakhon Nayok**: Nang Rawng, c. 100 m, 24 Nov 1937, *Smitinand, T. 3881* (BKF). **Nakhon Ratchasima**: Cultivated at RBG Edinburgh from Middleton, D.J. 5641, accession number 20121420, 21 Nov 2012, *Middleton, D.J. 5288* (E, SING [2 sheets]); Pak Chong, Wat Tham Phrom Machan Thammaram, 480 m, 22 Aug 2012, *Middleton, D.J. et al. 5641* (BKF, E); Pak Chong, Khao Yai National Park, 19 Sep 2002, *Charoenchai, P. & Poompuang, S. 329* (CMUB); Khao Yai National Park, Nam Dohk Lek Falls, 20 Oct 2003, *Palee, P. 646* (E); Khao Yai National Park, 8 Aug 1979, *Shimizu, T. et al. 9481* (BM, L). **Saraburi**: Ban Nawng Bua, 1 Oct 1927, *Put, N. 1116* (ABD mixed specimen, see also *M. tubulosa*); Muak Lek, Khao Hin Fon, Pa Chai Badan, 19 Nov 2011, *Suparinyo, P.P. s.n.* (BKF [2 sheets]); Muak Lek, 3 Sep 1928, *Put, N. 1854* (K); Cult. Hort. Bot. Reg. Kew from Marcan 1872, 11 Nov 1925, 685.25 (K); Khao Sawng Phi Nawng, c. 400 m, 4 Oct 1963, *Smitinand, T. & Sleumer, H.O. 1348* (BKF, E, K, L).

Notes. This species is easily recognised by the large, orange corolla. It is most similar to *Microchirita tubulosa*, which however has a white flower with purple lateral markings and a ventral yellow line.

In the protologue, Craib (1926) cited the wild collection *Marcan 1872* and a cultivated plant grown in Aberdeen from seeds of this plant and noted that the description was largely based on the cultivated plant. This would make the cultivated plant a better choice for lectotypification but we have been unable to find any material unequivocally vouchered from this living collection in Aberdeen before publication of the protologue.

17. *Microchirita micromusa* (B.L.Burt) A.Weber & D.J.Middleton, *Taxon* 60: 778 (2011). – *Chirita micromusa* B.L.Burt, *J. Roy. Hort. Soc.* 85: 28 (1960); Barnett, *Fl. Siam.* 3: 226 (1962); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 194 (1974); Burt, *Thai Forest Bull., Bot.* 29: 88 (2001). – TYPE: Thailand, Nakhon Nayok, cult. in Montreal Botanic Garden from seeds collected by Raymond & Smitinand, *Raymond, M. ref. 106-59* (holotype E [E00155279]).

Caulescent herb to 30 cm tall, internodes 4–7 cm long. **Stems** succulent, glabrescent or sparsely eglandular hairy, branching from the petiole of the basal leaf. **Leaves** opposite apart from the basal leaf; petioles to 3 cm long, glabrescent; blades lanceolate to elliptic, 7–25 × 4.1–12 cm, 1.7–2.5 times as long as wide, base shortly attenuate to subcordate, apex acute to broadly acuminate, with eglandular hairs above and sparse hairs beneath, margin entire or minutely serrulate, 8–18+ pairs of secondary veins. **Inflorescences** cristate, 4–10-flowered (20 according to the protologue), floral axes sparsely eglandular hairy to glabrescent; peduncles short and fused with each other; bracts absent; pedicels straight or curved, 7–16 mm long. **Calyx** actinomorphic, lobes divided to base, lanceolate, 7.5–13 × 1.2–1.7 mm apex acute, margin entire, with minute glands on both sides, and a sparse eglandular indumentum outside on margin and midrib. **Corolla** 20–26 mm long, yellow with an orange patch ventrally, narrow at base then gradually broadening, with eglandular hairs along the upper part of the tube and glandular hairs inside by the mouth; tube c. 16.5 mm long dorsally, c. 17.5 mm

laterally, c. 20 mm ventrally; lobes elliptic with rounded apex, upper lobes $3.5\text{--}4.5 \times 6$ mm, lateral lobes $5\text{--}6 \times 6$ mm, lower lobe $5\text{--}6 \times 5.5$ mm. **Stamens** arising c. 11 mm above the corolla base, filaments straight, sparsely eglandular hairy, c. 3 mm long, c. 0.3 mm diameter; anthers pale, with a dimorphic indumentum of long purple hairs pointing upwards and short straight white hairs pointing down, arising from the base of the anther, anthers c. 1.5×1.5 mm, apically joined by a connective, thecae slightly divergent; staminodes 2, 0.4 mm long, arising 7.5 mm above the corolla base. **Disk** annular, slightly lobed, 0.4–0.6 mm tall. **Pistil** c. 15 mm long; ovary c. 6 mm long, glabrous or finely glandular at base, eglandular hairy in the upper 1/3; style curved, c. 6 mm long, hairy; stigma lower lip elongate, 1.2–1.5 mm long, 1 mm wide. **Fruit** straight or occasionally slightly curved, c. 5–6 cm long, narrow, with sparse glands along most its length and eglandular hairs terminally. **Seeds** not seen.

Distribution. Central and eastern Thailand. Possibly also occurring in Nakhon Ratchasima (photos from Sukonthip Sirimongkol seen).

Habitat. “On sandy soil in deciduous forest”. Habitat data are missing from most collections of this species but it is noteworthy that the collection localities appear to be from areas that do not have karst limestone or a limestone bedrock. This makes it unusual in the genus.

Provisional IUCN conservation assessment. Data Deficient DD. There are rather few collections of this species and many of these are more than 40 years old. Further collections are needed in the Khao Yai and Sisaket areas to set a conservation assessment.

Additional specimens seen. **Unknown province:** Cultivated at Cornell University, Ithaca, originally from Montreal Botanical Garden, 23 Oct 1958, *Moore, J.R.* 7685 (E); Cult. RBGE, received from Smitinand, C3797 (E); Cult. RBGE, received from Frankfurt BG in 1964, Sep 1964, C4327 (E). **THAILAND:** **Nakhon Nayok:** *Suvatabundha, K., s.n.* (BK); Muang, Nahng Rawng falls [Nang Rong Waterfall], 16 Sep 1972, *Maxwell, J.F.* 72-355 (AAU, BK); ibidem, c. 100 m, 22 Oct 1960, *Smitinand, T.* 6984 (A, E, K). **Sisaket:** Kantalak, Panomdongrak Wildlife Sanctuary, Samrong Kiat Waterfall, 300 m, 21 Oct 2003, *Palee, P.* 647 (CMU).

Notes. *Microchirita micromusa* is similar to *M. elphinstonia*, from which it differs in the orange patch in the corolla and in the clearly dimorphic anther indumentum. Burt named it “micromusa” because M. Raymond described the fruits as “a miniature hand of bananas” (Burt, 1960). However, short, curved fruits are rather more characteristic of another yellow-flowered species, *Microchirita bimaculata*, than of *M. micromusa*. There has been some confusion between the two species, resulting in many specimens of *M. bimaculata* from Northern Thailand being misidentified as *M. micromusa*. *Microchirita micromusa* is distributed in Central and Eastern Thailand and is not known to overlap with the distribution of *M. bimaculata*.

18. *Microchirita mollissima* (Ridl.) A. Weber & D.J. Middleton, *Taxon* 60: 778 (2011). – *Chirita mollissima* Ridl., *J. Linn. Soc., Bot.* 32: 517 (1896); Barnett, *Fl. Siam.* 3: 226 (1962); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 188 (1974); Burt, *Thai Forest Bull., Bot.* 29: 88 (2001). – TYPE: Siam [Thailand], Pungah [Phangnga], July 1893, *Curtis 2944* (lectotype SING [SING0117733] designated by Wood (1974: 188), isolectotype K [K000450489], SING [SING0117731] [SING0117732] [SING0117734] [SING0117735]). (Fig. 12A–C)

Notes. *Microchirita mollissima* is easily recognised by its elongated and sessile or subsessile leaves with a dense white indumentum, and by the nearly axillary inflorescences. Three varieties can be distinguished in Thailand.

Key to the varieties of *Microchirita mollissima*

- 1a. Anthers hairy, with a small projection at the filament insertion 2
- 1b. Anthers glabrous, without a projection at the filament insertion
..... 18b. *M. mollissima* var. *glabra*
- 2a. Leaves, calyx and corolla with eglandular indumentum only
..... 18a. *M. mollissima* var. *mollissima*
- 2b. Leaves, calyx and corolla with glandular indumentum
..... 18c. *M. mollissima* var. *glandulophylla*

18a. *Microchirita mollissima* var. *mollissima*

Caulescent perennial herb to 50 cm tall with elongated stem runners, internodes to c. 2 cm. **Stems** not fleshy, densely hairy. **Leaves** opposite, condensed at the stem apex; petioles inconspicuous or to 2.5 cm long, densely eglandular hairy; blades pale to dark green above with silvery white soft hairs, grey-green, flushed purple beneath, lanceolate, 3.5–28 × 0.7–9 cm, 2.2–7.2 times as long as wide, base acute to attenuate, often unequal, apex acute to acuminate, densely eglandular tomentose above and beneath, margin entire to irregularly denticulate, 6–14 pairs of secondary veins in the opposite leaves, venation slightly sunken above and raised beneath in fresh material, tertiary venation inconspicuous. **Inflorescences** cristate, peduncles 10–60 mm, not fused to each other, densely eglandular hairy, the first inflorescence is rarely compound and bracteate. **Calyx** green, tube c. 0.3 mm long, lobes lanceolate, 5–14 × 1.5–4 mm, apex acute, eglandular hairy on both sides, with additional sparse, minute glands inside. **Corolla** 18–33 mm long, blue, pale blue, purple, pink or white, tube creamy white or greenish white, lobes very pale lilac, dorsal fringe of yellow/orange glandular, papillose hairs inside, narrow at base (7–11 mm, c. 2.2 mm diameter), then slightly curved downwards and gradually broadening, lobes not reflexed, eglandular pubescent outside except at base, especially dorsally between the upper lobes and ventrally below the central lobe; tube 14–26 mm long dorsally, 20–36 mm ventrally,

14–28 mm laterally between lips; upper lobes broadly elliptic, $4\text{--}7 \times 7\text{--}11$ mm, lower lateral lobes elliptic, $3\text{--}12.5 \times 4\text{--}13$ mm, lower central lobe round-elliptic, $4.5\text{--}10.5 \times 6.5\text{--}17$ mm. **Stamens** arising 7.5–16 mm above the corolla base; filaments white or pale yellow, glabrous, 7.5–9 mm long, 0.8–1.3 mm wide; anthers white or pale yellow, hairy dorsally, $3.5\text{--}4.5 \times 2\text{--}2.5$ mm, apically coherent but not joined by a connective, thecae divergent; lateral staminodes 3.5–4.5 mm long, 0.2 mm wide, arising c. 7.5–16 mm above the corolla base, central staminode 0.6 mm long, arising c. 8 mm above the corolla base. **Disk** annular, margin irregular, dark, 0.4–0.5 mm high. **Pistil** 13 (immature)–28 mm long, eglandular hirsute throughout; ovary 0.7–1.3 cm long, c. 1 mm diameter; style c. 1.2 cm; stigma broadly bilobed, lobes 1.1–2 mm long, 0.9–1.3 mm wide, elliptic. **Fruit** brown when ripe, 3–7 cm long, 1–1.5 mm diameter, densely eglandular hairy, straight. **Seeds** not seen.

Distribution. Peninsular Thailand.

Habitat. On limestone, in shade.

Provisional IUCN conservation assessment. Near Threatened NT. This variety has an EOO and an AOO within the limits to be considered endangered; it is, however, known from many localities.

Additional specimens examined. **Unknown locality:** 1930, *Kerr, A.F.G.* 240 (L). THAILAND: **Krabi:** Nai Chong, Khap Thong Thai, 30 m, 19 Jan 1966, *Hansen, B. & Smitinand, T.* 11997 (BKF, E, K, SING); Aoluk, Ban Naiyuan Khaek, c. 20 m, 5 Sep 1982, *Shimizu, T. et al.* T-29113 (BKF); Mueang Krabi, Tambon Krabi Noi, Wat Tham Sua, 85 m, 11 Sep 2008, *Middleton, D.J. et al.* 4443 (BKF, E); Cult. RBGE from Middleton, D.J. et al. 4443, *Middleton, D.J.* 5208 (E); Khao Phanom Bencha National Park, c. 100 m, 13 Sep 1983, *Smitinand, T. s.n.* (BKF); between Krabi and Panom Bencha, 0 m, 24 Oct 1991, *Larsen, K. et al.* 42534 (AAU, BKF); Muang, near Panom Bencha National Park, Tham Khao Pheung, 60 m, 17 Jun 2006, *Williams, K. et al.* 1826 (BKF); Khao Kopi, c. 50 m, 14 Aug 1965, *Smitinand, T.* 8929 (BKF); Ao Luk, 8 Oct 1970, *Charoenphol, C. et al.* 3444 (AAU, E); Plai Praya, Wat Ban Hian, 24 Sep 2010, *Triboun, P. & Sonsupab, B.* 4583 (E). **Phang Nga:** Pungah, 6 Dec 1918, *Haniff & Nur* 3880 (SING); Muang, Tham Khao Ngoom, 20–50 m, 7 Sep 1982, *Shimizu, T. et al.* T-29191 (BKF); Mueng, Suan Somdej, 11 Dec 1986, *Phengklai, C. & Smitinand, T.* 6015 (BKF); Tupput, Tham Saeng Tham Nimit Dharma office, 60 m, 23 Feb 2001, *Chayamarit, K. et al.* 2655 (BKF); Mueang, Thamnamphood, c. 50 m, 1 Jan 2000, *Wongprasert, T.* 001-11 (BKF); Mueang, Sra Nang Manora Forest Park, 224 m, 17 Nov 2014, *Suddee, S. et al.* 4800 (BKF); Khao Phang Nga, 200 m, 27 Feb 1929, *Kerr, A.F.G.* 17265 (K); Muang Phangnga, Sra Nang Manora Forest Park, 16 Sep 2010, *Middleton, D.J. et al.* 5449 (E); Kan Bow Koranee cascade, 9 May 1973, *Geesink, R. & Santisuk, T.* 5292 (L). **Surat Thani:** Phanom, Khlong Phanom National Park, 200 m, 7 Sep 2008, *Middleton, D.J. et al.* 4361 (BKF, E).

18b. *Microchirita mollissima* var. *glabra* C.Puglisi, var. nov.

Differs from the type variety in the lack of an indumentum dorsally on the anthers and the small projection of the filament at the insertion. – TYPE: Thailand, Krabi,

Tum Pra Sat Na Ra Ki Ling, c. 50 m, 29 October 2006, *Triboun, P. 3671* (holotype E [E00428772]).

Distribution. Thailand (Krabi).

Habitat. On limestone.

Provisional IUCN conservation assessment. Data Deficient DD. This variety is only known from the type collection and its distribution is too poorly known.

Note. The corolla of the type specimen is reported to be pale pink.

18c. *Microchirita mollissima* var. *glandulophylla* C.Puglisi, var. nov.

Differs from the type variety by the glandular indumentum on the calyx and corolla, and the mixed glandular and eglandular indumentum on the leaves. – TYPE: Thailand, Phang Nga, Ban Tham Thong Lang, c. 50 m, 25 January 1969, *Smitinand, T. & Scheller, R. 10642* (holotype BKF).

Distribution. Thailand (Phang Nga).

Habitat. On limestone rocks.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii) + B2ab(iii). This species has an EOO and AOO of < 20 km² and is only known from a small number of collections from fewer than 5 locations, not all of which are in protected areas.

Additional specimens examined. THAILAND: **Phang Nga:** Thap Put, Khao Sam’kob, c. 80 m, 24 Aug 1967, *Shimizu, T. et al. T-7903* (BKF); Tham Thong Lang, 50 m, Jun 1971, Cultivated RBGE, accession number 691872, vouchered as *C8246* (E); Muang Phangnga, 29 Sep 2006, *Triboun, P. 3665* (E).

19. *Microchirita oculata* (Craib) A.Weber & D.J.Middleton, Taxon 60: 778 (2011). – *Chirita oculata* Craib, Bull. Misc. Inform. Kew. 174 (1930); Barnett, Fl. Siam. 3: 226 (1962); Wood, Notes Roy. Bot. Gard. Edinburgh 33: 194 (1974); Burt, Thai Forest Bull., Bot. 29: 88 (2001). – TYPE: “described from a plant which flowered in Aberdeen in Jul 1928. It was raised from seed of *Kerr 9750* which was collected on Kao Sakan, 6 November 1928” (lectotype ABD, designated by Wood (1974: 194); isolectotype E [E00155281]). (Fig. 12D–F)

Caulescent herb to 40 cm tall, internodes 1–11 cm. *Stems* succulent, green, eglandular tomentose; branches sometimes arising from the petioles of the basal leaf. *Leaves* opposite, apart from the basal leaf; petioles 0.2–1.7 cm long, green, sparsely eglandular

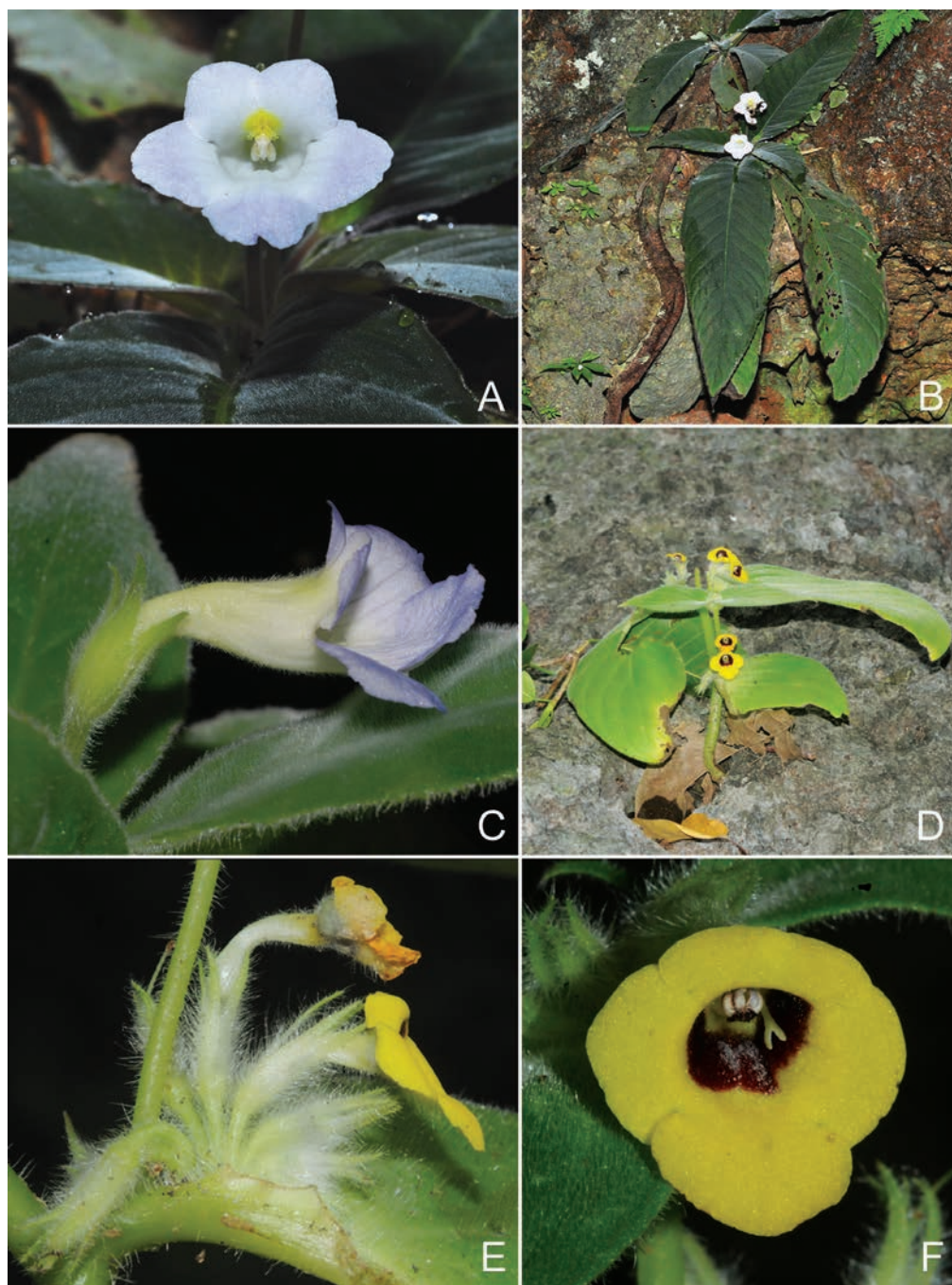


Fig. 12. *Microchirita mollissima* (Ridl.) A.Weber & D.J.Middleton var. *mollissima*. **A.** Front view of the flower. **B.** Habit. **C.** Side view of the flower. A, B from Middleton, D.J. *et al.* 5449; C from Middleton, D.J. 5208. *Microchirita oculata* (Craib) A.Weber & D.J.Middleton. **D.** Habit. **E.** Side view of the flower. **F.** Front view of the flower. All from Middleton, D.J. *et al.* 5581. (Photos: A, B, T. Phutthai; C, D.J. Middleton; D–F, P. Triboun)

hairy; blades green above, paler beneath, ovate or lanceolate, $4\text{--}16 \times 1.7\text{--}10$ cm, 1.4–2.4 times as long as wide, base obtuse to subcordate, apex acute to acuminate, dimorphic eglandular indumentum above, more sparsely so beneath, ciliate along the margin, margin entire to obscurely toothed, 5–14 pairs of secondary veins, steeply ascending, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation lax. **Inflorescences** cristate, all axes with a dense indumentum of white eglandular hairs; peduncles reduced or to 2 mm long, not fused with each other; bracts absent; pedicels pale green, 1–6 mm long. **Calyx** whitish green, actinomorphic, tube 0.5 mm, lobes triangular, $11.5\text{--}13 \times 1.4\text{--}1.6$ mm wide, apex acuminate, margin entire, densely eglandular hairy outside, inside hairy only towards the tip. **Corolla** 16–20 mm long, bright yellow, with a dark reddish brown ring at the throat, tube narrow, straight or curved, abruptly widening, lobes spreading, the ventral prominent, eglandular hairy outside, papillose inside, especially on the lobes, and with larger glands at the base of the upper lobes; tube 14–17 mm long dorsally, 15–18 mm ventrally, 14–16 mm laterally between lips; lobes broadly orbicular and imbricate, apices obtuse to rounded, margin obscurely crenulate, upper lobes $2.5\text{--}4.5 \times 4.5\text{--}6.5$ mm, lateral lobes $4\text{--}5 \times 5\text{--}9$ mm, ventral lobe $4\text{--}8 \times 6\text{--}11$ mm. **Stamens** arising 9–10.5 mm above the corolla base; filaments straight, glabrescent or sparsely hairy, 1.5–2 mm long, 0.2 mm wide; anthers white, with an indumentum of thick, probably glandular, dark hairs dorsally, $1.3\text{--}2 \times 1\text{--}1.1$ mm, apically joined by a connective, thecae divergent, the apices pointing towards the base of the corolla; staminodes all inconspicuous, or only the lateral staminodes present, lateral staminodes 1–9 mm long, arising 2.1–7 mm above the corolla base. **Disk** a small ventral lobe up to a $\frac{1}{2}$ – $\frac{3}{4}$ ring, 0.4–0.5 mm high. **Pistil** c. 12 mm long; ovary c. 5 mm long, 0.7–0.8 mm diameter, glabrous at the base, densely covered in white hairs apically; style c. 5.5 mm long, hairy, becoming glabrescent towards the top; stigma glabrous or papillose-plumose, 1 mm long. **Fruit** 3–4 cm long, slightly curved. **Seeds** not seen.

Distribution. Eastern Thailand (Sa Kaeo).

Habitat. On limestone.

Provisional IUCN conservation assessment. Endangered EN B1ab(iii). This species has a very small EOO and AOO, being only known from the Khao Chakan District of Sa Kaeo Province. None of the known localities are in protected areas and are subject to high human disturbance.

Additional specimens examined. THAILAND: **Sa Kaeo:** Khao Chakan, Wat Ratanakiri, 100 m, 21 Aug 2012, *Middleton, D.J. et al.* 5581 (BKF, E, P); Khao Chakan Temple, 88 m, 17 Oct 2010, *Staples, G. et al.* 1408 (BKF, E, SING); Krabin, Kao Sakan, c. 50 m, 24 Dec 1924, *Kerr, A.F.G.* 9750 (ABD, BK, BM, K [2 sheets]).

Notes. This plant is easily recognised by its corolla colour pattern: yellow, with a dark reddish brown ring at the throat. All other species of *Microchirita* which have a yellow or orange corolla have smaller lateral spots at each side of the ventral corolla lobe.

Another characteristic feature of *Microchirita oculata* is the dense white indumentum on the pedicels and calices. Floral dissection of the material available suggest this species to be strongly protandrous.

20. *Microchirita personata* C. Puglisi, Kew Bull. 71(1)-2: 1 (2016). – TYPE: Thailand, Uthai Thani, Lan Sak, Huppatat Non Hunting Area, 122 m, 14 October 2014, Middleton, D.J., Hemrat, C., Karaket, P., Puglisi, C. & Suddee, S. 5688 (holotype BKF; isotypes AAU, E [E00663026], K, SING). (Fig. 13A–C)

Herb to 35 cm tall. **Stems** fleshy, pale green, glabrous or sparsely hairy. **Leaves** opposite, with the exception of the single basal leaf, fleshy (very thin when dry); petioles 0.1–0.5 cm long, sparsely hairy; blades pale green above, pale grey-green beneath, lanceolate, $3.4\text{--}40 \times 1.7\text{--}29$ cm, 1.3–2.2 times as long as wide, base usually rounded obtuse, sometimes slightly cordate or slightly decurrent, apex acuminate to acute, minutely tomentose above and beneath, margin entire, 6–11 pairs of secondary veins in the opposite leaves, 8–14 pairs in the basal leaf, venation raised beneath in fresh material, tertiary venation barely visible and loosely reticulate. **Inflorescence** epiphyllous, many-flowered (10 to more than 20 flowers), cristate; peduncles reduced; bracts absent; pedicels pale green, 5–13 mm long, pubescent. **Calyx** green, slightly bilabiate, tube 0.4–0.7 mm long, lobes lanceolate, $4\text{--}7 \times 0.4\text{--}0.6$ mm, membranous along the margins, apex more or less narrowly obtuse, outside eglandular hairy throughout, inside only towards the apex. **Corolla** 7–10 mm long, tube greenish white, upper lip pale green, lower lip white, with a densely papillose yellow marking at base, tube narrowly tubular, mouth personate due to the raised ventral lip, upper lip strongly reflexed upwards, tube glabrous at the base, limb densely pubescent outside, densely papillose inside; tube 4–8 mm long dorsally, 6–9 mm ventrally, 4–7 mm laterally between lips; upper lobes small and elliptic, $0.7\text{--}0.8 \times 1\text{--}1.3$ mm, lower lateral lobes elliptic, $1.5\text{--}1.8 \times 2.2\text{--}2.3$ mm, lower central lobe elliptic, $1.2\text{--}1.3 \times 1.8\text{--}3$ mm. **Stamens** arising 2.7–3.7 mm above the corolla base, filaments pale green, glabrous, 0.5–1.2 mm long; anthers white, glabrous, $1.1\text{--}1.7 \times 0.3\text{--}0.5$ mm, apically joined by a connective, thecae slightly divergent; lateral staminodes absent or to 0.2 mm long, arising c. 1.7 mm above the corolla base, central staminode extremely reduced or absent. **Disk** a ventral lobe, 0.6–1 mm high. Pistil 2.2–2.3 mm long; ovary urceolate, c. 1.5 mm, glabrous or sparsely glandular at base, apically eglandular hairy; style c. 0.6 mm, hairy; stigma broadly bilobed, lobes 0.1–0.2 mm long, rounded. **Fruit** green, 1–3 cm long, 1–2 mm diam., hairy almost exclusively in the terminal half, straight or curved. **Seeds** pale brown, elliptic, $0.4\text{--}0.5 \times 0.2\text{--}0.3$ mm.

Distribution. Northern Thailand (Uthai Thani).

Habitat. On limestone in secondary forest.

Provisional IUCN conservation assessment. Critically Endangered CR B1ab(iii,iv) +

B2ab(iii,iv). This species is only known from the type collection in the Huppatat Non Hunting Area, where only one, small population was observed. The limestone range there is only about 12 km² in total and is subject to disturbance from tourism. There are no collections from the nearby Khao Pha Ra, and the area is surrounded by cultivated land.

Additional specimens examined. THAILAND: **Uthai Thani:** Lan Sak, Huppatat Non Hunting Area, 19 Sep 2015, *Tanming*, W. 901 (QBG).

Notes. This species can be recognised by the small, personate corolla and the glabrous anthers. The measurements reported are largely based on the original publication in Puglisi et al. (2016), integrated with the newly acquired material.

21. *Microchirita purpurea* D.J.Middleton & Triboun, Thai Forest Bull., Bot. 41: 14 (2013). – TYPE: Thailand, Chanthaburi, Kaeng Hang Maeo, Khao Chamao National Park, Wat Khao Wong Kot, 30 m alt., 27 August 2012, *Middleton, D.J., Karaket, P., Suddee, S. & Triboun, P.* 5681 (holotype BKF; isotypes A [00435722], BK, E [E00626983], K, P [P00966760], QBG, SING [SING0229833]). (Fig. 13D–F)

‘*Chirita* sp. nov.’ in Barnett, Fl. Siam. 3: 228 (1962).

Caulescent herb 25–100 cm tall with elongated stem runners, internodes 2–10 cm. **Stems** succulent, green with reddish parts, with a sparse hispid eglandular indumentum; branches sometimes arising from the petioles. **Leaves** opposite, with the exception of the basal leaf; petioles 2–9.5 cm long, reddish, sparsely eglandular hairy; blades pale green above and beneath, ovate or obovate, 4.3–20 × 2.7–9.5 cm, 1.3–1.8 times as long as wide, base cordate, apex acuminate, sparsely hairy above and beneath with a dimorphic indumentum of longer and shorter eglandular hairs ciliate along the margin, margin entire, 9–23 pairs of secondary veins, steeply ascending, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation inconspicuous. **Inflorescences** cristate, peduncles reduced or emerging and fused together; peduncle absent or to 5 mm long; bracts absent; pedicels pale green or tinged with reddish purple, 5–30 mm long, densely pubescent. **Calyx** green, actinomorphic, completely divided to base, lobes narrowly ovate, 7–9.5 × 1.5–1.9 mm, apex acuminate, pubescent. **Corolla** 24–30 mm long, purple, slightly paler on tube and lobes, darker in the throat, tube narrow at base, curved, then widening abruptly into a campanulate upper tube, lobes not spreading, purple, eglandular hairy outside, glabrous inside, except for a patch of glandular hairs dorsally in the tube by the anthers; tube c. 19–19.5 mm ventrally; lobes broadly orbicular, apices rounded, upper lobes 4 × 6 mm, lateral lobes 6 × 9.5 mm, ventral lobe c. 5–8.5 × 13–15 mm. **Stamens** arising from the point where the tube widens, c. 9 mm above the corolla base, filaments upright, glabrous, c. 1.5 mm long, c. 0.2 mm wide; anthers white or pale yellow, attached at a right angle from the filament, with hairs by the filament insertion,

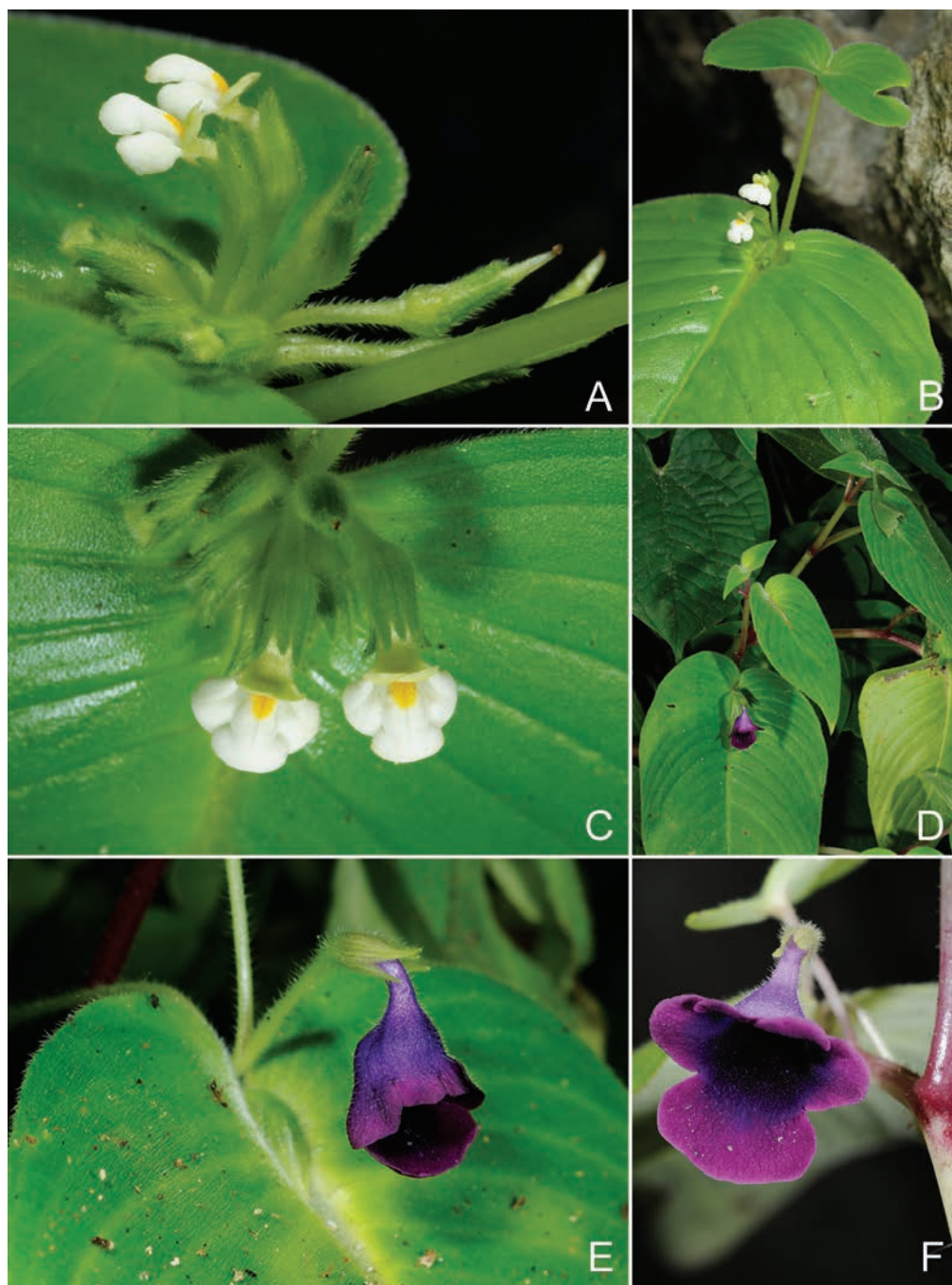


Fig. 13. *Microchirita personata* C.Puglisi. **A.** Inflorescence. **B.** Habit. **C.** Detail of the flower from above. All from Middleton, D.J. et al. 5688. *Microchirita purpurea* D.J.Middleton & Triboun. **D.** Habit. **E.** Lateral view of the flower. **F.** Front view of the flower. All from Middleton, D.J. et al. 5681. (Photos: P. Karaket)

c. 2.5×1.5 mm, apically joined by a connective, thecae parallel; lateral staminodes c. 1 mm long, arising near the corolla base, central staminode c. 0.7 mm long, arising near the corolla base. **Disk** annular, lobed, 1 mm high. **Pistil** c. 12 mm long; ovary 5 mm long, c. 0.5 mm diameter, glabrous; style 7 mm long, glabrous; stigma chiritoid, sparsely glandular, c. 1.2 mm long. **Fruit** green when immature, c. 4 cm long, c. 2 mm diameter, glabrous, curved. **Seeds** not seen.

Distribution. Southeastern Thailand. Vietnam.

Habitat. On limestone.

Provisional IUCN conservation assessment. Endangered EN B2ab(iii). This species is common at the type locality and can be observed occurring high up on rather inaccessible cliffs. At the site where it was collected there is only about 1 km² of suitable habitat and the base of the outcrop and the surroundings are degraded by human activity. The only other locality where it has been collected is just over 400 km to the SE from the type locality in southern Vietnam. Available limestone sites inbetween are rather few.

Additional specimens examined. THAILAND: **Rayong**: 25 Oct 1960, Chandraprasong, K. 69 (BK); Temple near Khao Chamao, 20 Sep 2000, Watthana, S. & Wongnak, M. 991 (QBG).

Notes. This species can be recognised by the dark purple colour of the corolla, the abruptly campanulate corolla, and the small upper two lobes and the broad lower three lobes of the corolla. The description is largely based on the original publication (Middleton & Triboun, 2013), with some additional data.

22. *Microchirita rupestris* (Ridl.) A. Weber & Rafidah, Taxon 60: 779 (2011); Rafidah, Gard. Bull. Singapore 69: 18 (2017). – *Chirita rupestris* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 59 (1905); Barnett, Fl. Siam. 3: 227 (1962); Wood, Notes Roy. Bot. Gard. Edinburgh 33: 201 (1974); Burt, Thai Forest Bull., Bot. 29: 89 (2001). – TYPE: Malaysia, Kedah, Langkawi, on damp rocks, sea level, November 1889, Curtis 2120 (lectotype SING [SING0042989], designated by Puglisi in Rafidah (2017: 18); isolectotype SING [SING0042990]). (Fig. 14)

Chirita glasgovii Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 60 (1905). – TYPE: Malaysia, Perak, Waterloo Estate, December 1897, Robertson-Glasgow s.n. (holotype SING [SING0042988]).

Chirita kerrii Craib, Bull. Misc. Inform. Kew 129 (1914); Barnett, Fl. Siam. 3: 225 (1962). – TYPE: Thailand, Mae Ping Rapids, Fa Man, in crevices of damp rock, 180 m, Kerr 2194 (lectotype K [K000545603], designated by Wood (1974: 200), isolectotype BM [BM000997770]).

Chirita geoffrayi Pellegr. in Lecomte, Fl. Indo-Chine 4: 529 (1930). – TYPE: Cambodia, Kampot, Kabal-Roméas, 18 October 1903, *Geoffray 123* (lectotype P [P00602516], designated by Wood (1974: 199)).

Chirita hamosa var. *unifolia* auct. non C.B. Clarke: Barnett, Fl. Siam. 3: 225 (1962).

Chirita caerulea auct. non R.Br.: Wood, Notes Roy. Bot. Gard. Edinburgh 33: 200 (1974), p.p.; Burt, Thai Forest Bull., Bot. 29: 87 (2001), p.p.

Terrestrial or lithophytic caulescent herb to 50 cm tall, not branching. **Stems** fleshy, eglandular hairy, green or purple-brown, with white and patent hairs, internodes to c. 13 cm. **Leaves** opposite, except for the single basal cotyledon; petioles 2–10 cm long, eglandular hairy; blades pale to dark green above with hispid eglandular hairs, pale green beneath, with the same type of indumentum, elliptic, ovate or lanceolate, $4.2\text{--}14.5 \times 1.8\text{--}7.5$ cm, 1.5–2.7 times as long as wide, base acute to obtuse or almost cordate, often unequal, apex acute to acuminate, margin entire to serrate, 7–16 pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, tertiary venation often inconspicuous. Leaves and bracts mid green above, whitish green beneath. **Inflorescences** arising from the petiole, at the axil or in close proximity, consisting of one to three main pedunculate inflorescences, each very compressed and thus appearing subumbellate and bearing 1–10 flowers; peduncle 2–140 mm long, eglandular hairy; bracts sessile, partly or completely fused in a cup, 5–50 mm long, with patent white eglandular hairs on both sides, palmate venation, margin serrate and when partly fused, with acute apex; pedicels green, 0.1–15 mm long, eglandular pubescent. **Calyx** yellow-green, bilabiate with the lower lobes shorter than the upper, tube 0.3–0.5 mm long, lobes narrowly lanceolate to triangular, $7\text{--}8 \times 1.1\text{--}1.2$ mm, apex narrowly acute, eglandular hairy on the outer side, sometimes only at the tip and along the margin, inside glabrous. **Corolla** 16.5–22 mm long, with tube white and lobes white to violet, with thin dark stripes and a yellow marking ventrally in the throat, tube narrow at base (5.5–6 mm), then abruptly opening into spreading lobes, tube glabrous, limb densely eglandular hairy outside, internally with dense glandular hairs in the throat, especially on the upper lip and on the ventral lobe, further in with shorter glandular hairs; tube c. 13–13.5 mm long dorsally, 12–16.5 mm ventrally, 11.5–13.5 mm laterally between lips; upper lobes broadly elliptic, $4.5\text{--}5.5 \times 4.5\text{--}6$ mm, lateral lobes elliptic, $4\text{--}5.5 \times 5\text{--}6$ mm, lower lobe elliptic, $4.5\text{--}6.5 \times 5.5\text{--}7$ mm. **Stamens** arising 6–9 mm above the corolla base, slightly bent, glabrous, 3.5–4 mm long, 0.4–0.5 mm wide; anthers pale yellow, hairy dorsally and partially beneath, $2\text{--}2.1 \times 1\text{--}1.3$ mm, free, thecae divergent; lateral staminodes 0.7–2.5 mm long, arising 5.5–7.5 mm above the corolla base, glabrous, central staminode 0.2–0.7 mm long, arising 6–8 mm above the corolla base. **Disk** a partial ring interrupted dorsally, lobed, 0.3–0.5 mm. **Pistil** 13.5–16.5 mm long; ovary 7.5–11 mm long, glabrous for 2–3 mm at base, otherwise densely eglandular hairy; style white, 4.5 mm, more sparsely hairy than the ovary; stigma white, elongated and flexed downwards, eglandular hairy, lobes $1.5\text{--}1.8 \times 0.4\text{--}0.5$ mm, elliptic. **Fruit** green, 1.1–4 cm long, c. 1.5 mm diameter, glabrous at the base, otherwise sparsely eglandular hairy, straight or slightly curved. **Seeds** not seen.

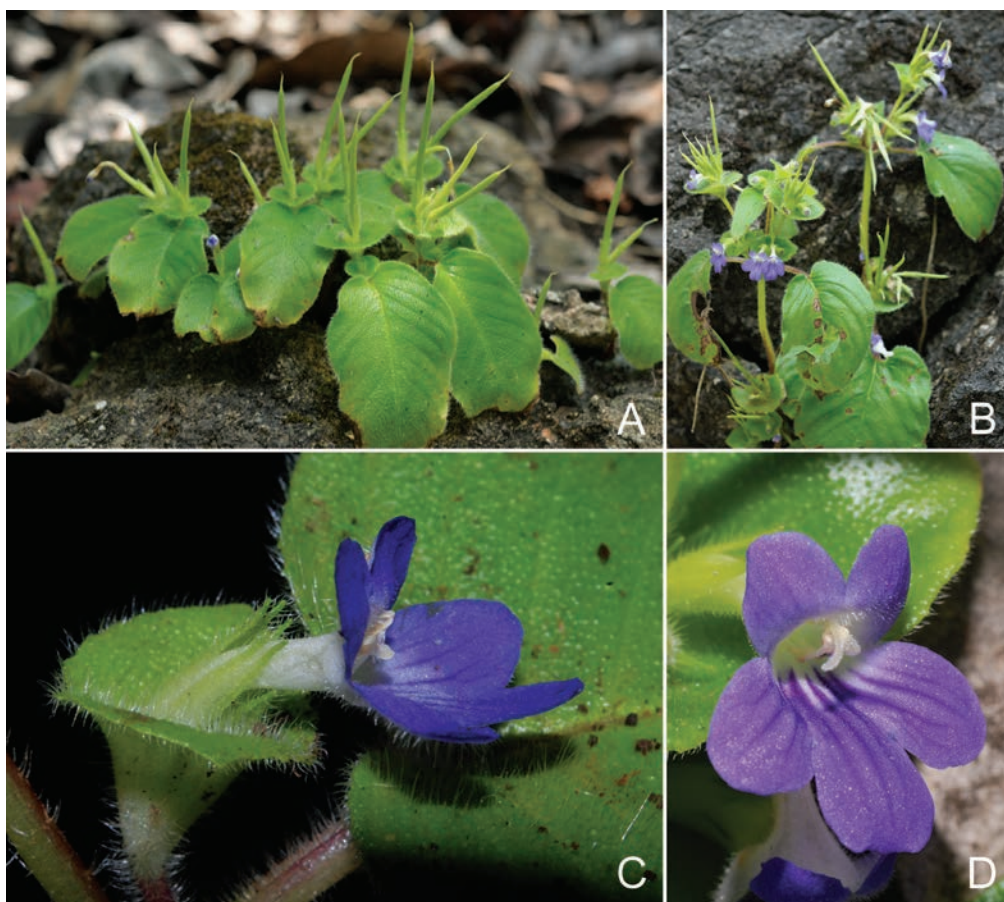


Fig. 14. *Microchirita rupestris* (Ridl.) A. Weber & Rafidah. **A.** Unifoliate habit. **B.** Caulescent habit. **C.** Side view of the flower. **D.** Detail of the corolla. A, B from Middleton, D.J. *et al.* 5721; C from Middleton, D.J. *et al.* 4836; D from Middleton, D.J. *et al.* 5204. (Photos: A, B, P. Karaket; C, D, D.J. Middleton)

Distribution. Widespread in Thailand. Cambodia, Vietnam, Malaysia.

Habitat. On rocks in shady areas.

Provisional IUCN conservation assessment. Least Concern LC. This species is common and widespread.

Additional specimens examined. THAILAND: **Ayutthaya:** s.l., c. 30 m, 21 Nov 1970, Smitinand, T. *et al.* 11377 (BKF, E). **Chiang Mai:** 400 m, 23 Nov 1920, Kerr, A.F.G. s.n. (BM); Sangampang, Muang Awn Cave, 525 m, 12 Oct 1989, Maxwell, J.F. 89-1221 (CMU, E); Mae On, 500 m, 7 Sep 2011, Pooma, R. *et al.* 7797 (BKF, E); Mae On, Doi Lohn, 13 Apr 2005, Palee, P. 799 (CMUB); Mae Ping Rapids 150 m, 17 Dec 1913, Kerr, A.F.G. 3044 (BM,

K); Keng Um Kong, Mae Ping Rapids, 250 m, 24 Nov 1920, *Kerr, A.F.G.* 4651 (BM, K, BK). **Kanchanaburi:** Ban Wangpho, 15 Oct 1967, *Chermisrivathana, C.* 791 (BK); Thong Pha Phum National Park, 130 m, 6 Sep 2007, *Suddee, S. et al.* 3268 (BKF); Thong Pha Phum, 22 Aug 2006, *Triboun, P.* 3635 (E); ibidem, 130 m, 15 Sep 2006, *Suddee, S. et al.* 2854 (BKF); ibidem, 240 m, 29 Nov 1982, *Koyama, H. et al.* T-30467 (BKF); Thong Pha Phum, Wat Tham Mong Kala, 5 Oct 2015, *Puglisi, C. et al.* CP409 (SING); Thong Pha Phum, Wat Tha Khanun, 170 m, 28 Oct 2009, *Middleton, D.J. & Triboun, P.* 5204 (BKF, E); Thong Pha Phum, Cha Lae, Ban Kroeng Krawia, 20 Sep 2011, *Sirimongkol, S.* 226 (BKF, SING), *S.* 227 (BKF); Erawan Waterfall, c. 150 m, 10 Oct 1971, *Murata, G. et al.* T-16141 (BKF, L); Mahidol University Campus, 4 Oct 2015, *Puglisi, C. et al.* CP402 (BKF); Sai Yok, Mahidol University Campus, 275 m, 13 Sep 2005, *Maxwell, J.F.* 05-489 (BKF, CMUB); Srisawat, Erawan National Park, 100–300 m, 3 Nov 1979, *Shimizu, T. et al.* T-21532 (BKF); Erawan National Park, 400 m, 18 Nov 1971, *van Beusekom, C.F. et al.* 3843 (L); Sai Yok, Khao Yen, 7 Oct 2015, *Puglisi, C. et al.* CP430 (BKF, E, MUKA, SING). **Lampang:** Ngao, near Tham Pha Thai, 520 m, 24 Sep 2014, *Middleton, D.J. et al.* 4585 (BKF, E). **Satun:** Tarutao Island, 30 m, Oct 1979, *Congdon 9* (E); Tha Lea Ban National Park, 250 m, 8 Dec 1986, *Niyomdham, C.* 1297 (BKF, E, K, P); Khuan Doan Khao Mot Oaeng, 456 m, 5 Sep 2013, *Suddee, S. et al.* 4574 (BKF); Langgu, Koh Kabeng, under 80 m, Sep 1999, *Phengkklai, C.* 12152 (BKF); Cult. Aberdeen from a Kerr collection in Satun, 27 Nov 1927, “185” (ABD); Cult. Aberdeen from a Kerr collection in Satun, 6 Nov 1927, “185” (ABD). **Tak:** Umphang, Umphang Wildlife Sanctuary, 860 m, 16 Oct 2014, *Middleton, D.J. et al.* 5721 (BKF, E); Tah Song Yang, Tham Usu, c. 500 m, 10 Sep 2009, *Middleton, D.J. & Triboun, P.* 4836 (BKF, E, P); Umphang, Umphang Wildlife Sanctuary, 868 m, 16 Oct 2014, *Middleton, D.J. et al.* 5711 (BKF, E). **Trang:** Huay Yot, Wat Tham Iso, 102 m, 9 Sep 2008, *Middleton, D.J. et al.* 4424 (BKF, E); Nam Tai, 11 Oct 1970, *Charoenphol, C. et al.* 3628 (AAU, BKF, E, K, L); Khao Pina, 150 m, 23 Oct 1991, *Larsen, K. et al.* 42504 (BKF); Palien, Lipang, Ban Tahkao, 50 m, 21 Nov 1986, *Maxwell, J.F.* 86-957 (CMU, L). **Trat:** Klong Kloi, Kaw Chang, 30 m, 30 Sep 1924, *Kerr, A.F.G.* 9260 (ABD [4 sheets], E, K).

Notes. Thai specimens from south of the Isthmus of Kra have leaves with longer petioles, more strongly serrate margin and more acuminate apex, and inflorescences less hairy on pedicels and bracts. Wood (1974) attributed some Thai specimens to *Microchirita caerulea* (R.Br.) Yin Z.Wang, an Indonesian species with a bracteate inflorescence. *Microchirita caerulea* has glandular hairs intermixed with eglandular hairs in the stem. The bracts are fused on one side only and have glandular and eglandular hairs along the margin. The peduncles have a mixed indumentum, too, and the pedicels are glandular. *Microchirita rupestris* does not have any glandular hairs. Furthermore, the leaf base is cordate in *Microchirita caerulea* and only very rarely so in *M. rupestris*.

23. *Microchirita suddeei* D.J.Middleton & Triboun, Thai Forest Bull., Bot. 41: 18 (2013). – TYPE: Thailand, Phrae, Rong Kwang District, Tham Pha Nang Khoi, 210 m alt., 17 August 2012, *Middleton, D.J., Karaket, P., Suddee, S. & Triboun, P.* 5618 (holotype BKF; isotypes E [E00629451], P [P00966761], QBG, SING [SING0229832]). (Fig. 15A–C)

Caulescent herb to 40 cm tall, internodes 4–13 cm. **Stems** succulent, pale green or red at base, sometimes branching from basal petiole, with sparse sessile glands. **Leaves** opposite, apart from the basal leaf; petioles 0.3–2.2 cm long, very sparsely eglandular hairy; blades mid green above, paler beneath, ovate, $4.2\text{--}35 \times 1.3\text{--}18.8$ cm, 1.3–3.3 times as long as wide, base rounded to cordate, apex acuminate, sparsely eglandular hairy above and beneath, sparsely ciliate along the margin, margin entire, 6–22 pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation laxly reticulate. **Inflorescences** cristate; peduncles fused, 2.5–5 mm long, fused together, glabrous; bracts absent; pedicels green, 4.4–11 mm long, sparsely hairy. **Calyx** green, bilabiate, the two lips completely divided, ventral tube c. 0.1 mm long, dorsal tube to c. 3.5–5 mm long, lobes ligulate, dorsal lobes 7.4–8 mm long, lower lobes 3–5 mm long, apex acute, margin entire, irregular towards the tip, sparsely hairy outside, hairier at the tip, sparsely glandular inside. **Corolla** 10–12 mm long, tube white, lobes pale lilac, tube narrow, straight or just slightly curved, lobes not always spreading, eglandular hairy outside, glabrous inside; tube c. 8 mm long dorsally, c. 10 mm long ventrally; lobes broadly orbicular, apices rounded or obtuse, upper lobes c. 2.6×3.7 mm, lateral lobes c. 2.4×4 mm, ventral lobe c. $1.8\text{--}3 \times 4$ mm. **Stamens** arising 3.2–4 mm above the corolla base, filaments slightly curved, glabrous, 2.2–2.5 mm long, c. 0.3–0.4 mm wide; anthers with an abundant indumentum at the sides and dorsally, $2.2\text{--}2.5 \times 1.1\text{--}1.2$ mm, apically joined by a weak connective. **Disk** a small ventral lobe, 0.1–0.6 mm high. **Pistil** c. 10 mm long; ovary 5.5–6.5 mm long, papillose in the bottom half, densely pubescent above; style white, 3.3–4 mm long, densely pubescent; stigma white, c. 1 mm long. Immature **fruit** 2–3 cm long, c. 1 mm diameter, glabrous, straight. **Seeds** not seen.

Distribution. Northern Thailand.

Habitat. On limestone in evergreen or mixed deciduous and bamboo forest.

Provisional IUCN conservation assessment. Vulnerable VU B1ab(iii) + B2ab(iii). The EOO is almost 10,000 km², well within the boundary for Vulnerable. However, the AOO is within the boundary for Endangered, not all of the localities are within protected areas, and limestone sites are degraded throughout the region. Since there are five known localities and there are likely to be more, an assessment of Vulnerable is more appropriate than Endangered.

Additional specimens examined. THAILAND: **Lampang:** Ngao, near Tham Pha Thai, 520 m, 24 Sep 2008, Middleton, D.J. et al. 4580 (BKF, E, P); Chae Hom, Ban Sa village, 15 Oct 2006, Palee, P. 1027 (A, CMUB). **Phrae:** Long, Doi Pha Klong National Park, Bah Gah Lahn Hill, 26 Oct 2005, Palee, P. 846 (A). **Tak:** Tha Song Yang, Doi Noi, 242 m, 6 Sep 2013, Phaosrichai, P. & Wongnak, M. 23 (QBG).

Notes. The floral characters reported are taken from the original description of *Microchirita suddeeii* (Middleton & Triboun, 2013), as no new material has been

identified during this study. This species can be recognised by the hairy anthers, the pale lilac corolla and the absence of a ventral line and lateral spots in the corolla. It is most similar to *Microchirita lilacina*, which has a broader mouth and glabrous anthers, and to *M. albiflora*, which is completely white and lacks sessile glands on the stem.

24. *Microchirita tadphoensis* C.Puglisi, sp. nov.

Most similar to *Microchirita hamosa* (R.Br.) Yin Z.Wang in the delicate habit and to *M. bimaculata* (D.Wood) A.Weber & D.J.Middleton in the shape of the corolla. Differs in having a shortly campanulate pale yellow corolla (white in *Microchirita hamosa*) with a ventral darker yellow marking but no lateral spots (spots always present in *M. bimaculata*). – TYPE: Thailand, Nakhon Phanom, Ban Phaeng, Phu Langka National Park, Tad Pho Waterfall, 224 m, 23 October 2015, *Suddee, S., Keiwbang, W. & Hemrat, C.* 4980 (holotype BKF; isotype SING). (Fig. 15D–F)

Herb to 20 cm tall, **stem** sparsely aglandular hairy, not branched, internodes c. 3 cm long. **Leaves** opposite, apart from the basal leaf; petioles 1–4 mm long, sparsely eglandular hairy; blade ovate to elliptic, $1.7\text{--}4.2 \times 1.2\text{--}3.2$ (a partial much larger basal leaf was seen that would be beyond these measurements if complete), 1.3–1.5 times as long as wide, base subcordate, apex acute to broadly acute, eglandular hairy on both surfaces, margin entire and ciliate, 7–9+ pairs of secondary veins, flat and scarcely visible on both sides. **Inflorescence** cristate, 1–5-flowered, floral axes eglandular hairy; bracts absent; pedicels 0.5–1.5 cm, straight or curved. **Calyx** pale green, slightly zygomorphic, lobes almost free, lanceolate-elliptic, $3\text{--}3.3 \times 0.5\text{--}0.9$ mm, lower lobes slightly larger than the upper, apex acute, margin entire, eglandular hairy outside, glabrous inside. **Corolla** c. 12 mm long, white outside, inside pale yellow with a yellow patch ventrally, base of tube narrow and curved, then gradually broadening, sparsely eglandular hairy outside, inside glabrous basally and with sessile glands apically and on the lobes; tube c. 9.3 mm dorsally, c. 9.7 mm ventrally and c. 8 mm between the lips; upper lobes c. 2×2.5 mm, lateral lobes c. 1.3×3 mm, ventral lobe c. 2×3 mm. **Stamens** arising c. 4.6 mm above the corolla base; filaments c. 2 mm long, 0.2 mm diameter, straight, glabrous at the base, with sessile glands in the top half; anthers c. 1.2×0.5 mm, probably ligate, with a small patch of straight hairs by the attachment, thecae strongly divergent; staminodes not seen. **Disk** absent. **Pistil** c. 10 mm long; ovary c. 5 mm long, c. 0.7 mm diameter, glabrous in the basal $1/3$ to $1/2$, then eglandular hairy; style c. 3.5 mm, delicate, eglandular hairy; stigma with lobes c. 0.7×0.5 mm, somewhat plumose inside. **Fruit** eglandular hairy, more or less curved, 1.7–3.4 cm long, 0.7–1.2 cm diameter. **Seeds** dark brown to black, broadly elliptic and furrowed, c. 0.5×0.2 mm.

Distribution. Northeastern Thailand.

Habitat. On sandstone in dry evergreen forest.

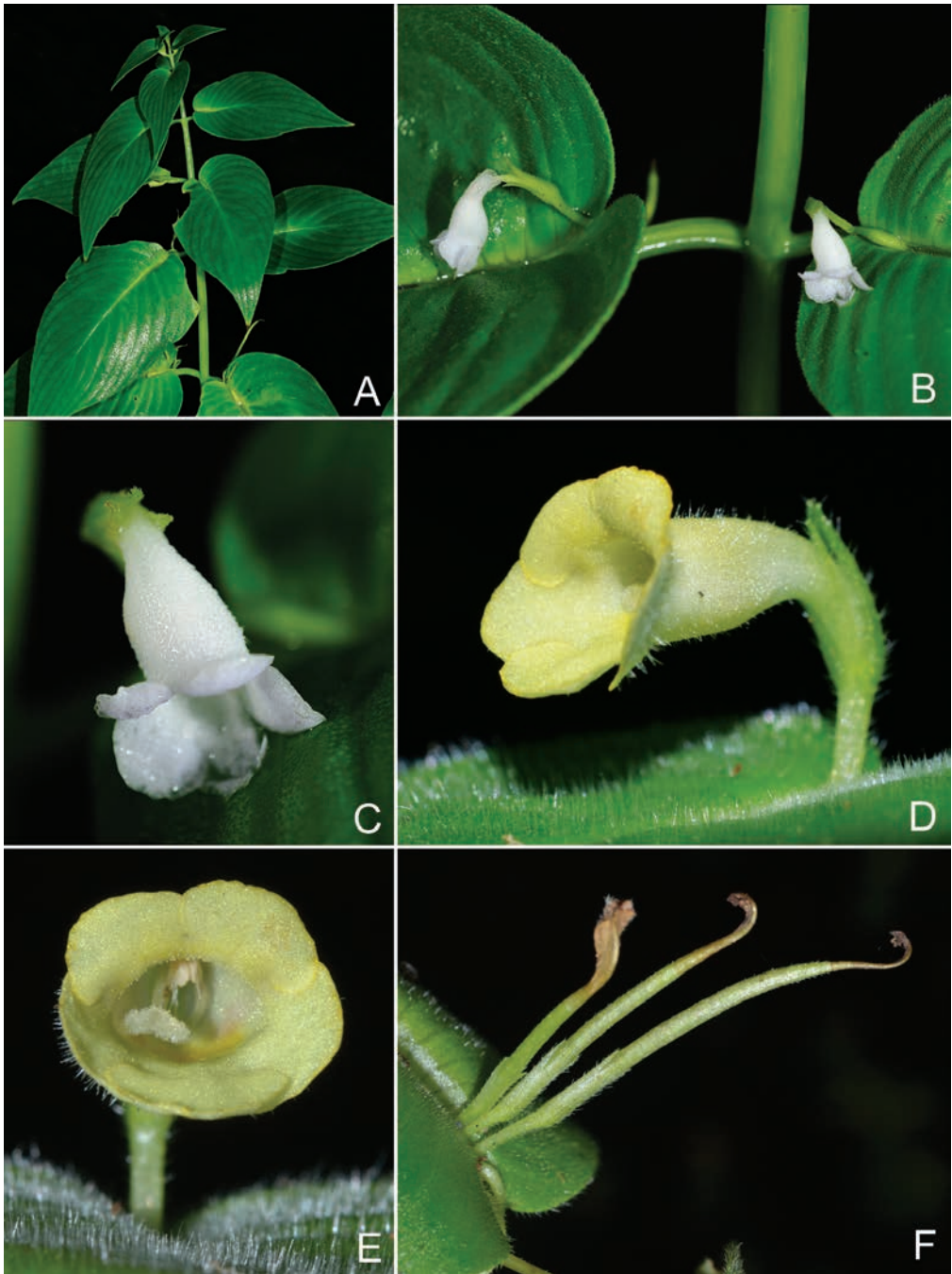


Fig. 15. *Microchirita suddeei* D.J.Middleton & Triboun. **A.** Habit. **B.** Inflorescences. **C.** Detail of the corolla. All from Middleton, D.J. *et al.* 5618. *Microchirita tadphoensis* C.Puglisi. **D.** Lateral view of the corolla. **E.** Front view of the corolla. **F.** Fruits. All from Suddee, S. *et al.* 4980. (Photos: A–C, P. Karaket; D–F, S. Suddee)

Provisional IUCN conservation assessment. Data Deficient DD. This species is only known from the type collection, which is within a protected area.

Notes. The epithet refers to the type locality.

25. *Microchirita tetsanae* C.Puglisi, sp. nov.

Species characterised by the presence of a dimorphic indumentum on the anthers and sparse hairs on the filaments, and by a little projection at the anther insertion. It is most similar to *Microchirita thailandica* C.Puglisi, but differs in the upper lobes not being imbricate with the lower, and in the filament projection. – TYPE: Thailand, Phetchabun, Mueang Phetchabun, Wat Tham Nam Bang, 130 m, 13 September 2014, *Tetsana, N. et al.* 855 (holotype BKF; isotype SING). (Fig. 16A–B)

Caulescent herb to 50 cm tall with elongated stem runners, internodes to 3.5–12.5 cm. **Stems** succulent, with some eglandular indumentum; branches to 30 cm long, sometimes arising from the petioles. **Leaves** opposite, apart from the basal leaf; petioles 0.1–2.5 cm long, eglandular hairy; blades mid green above, paler beneath, lanceolate to elliptic, 3–16 × 2.2–10 cm, 1.3–2.1 times as long as wide, base subcordate to cordate, apex acute to acuminate, finely pubescent above and beneath, ciliate along the margin, margin entire or sparsely and minutely denticulate, 6–17 pairs of secondary veins, venation slightly sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation inconspicuous. **Inflorescences** cristate, 1–5-flowered; peduncles reduced or 3–8 mm long, fused with each another, pubescent; bracts absent; pedicels pale green, 0.1–2.5 cm long, pubescent. **Calyx** pale green, succulent at the base, tube 0.3–0.5 mm long, lobes imbricate, narrowly lanceolate, 4.5–8 × 1–1.2 mm, apex acuminate and thickened, margin entire, outer indumentum of long eglandular hairs along the midrib, margin eglandular ciliate, inner indumentum of eglandular hairs at the tip and sparse sessile glands. **Corolla** 17–26 mm, tube white to pale blue, lobes white or purple-blue, the base of the upper lobes white or dark blue, lower lip pale blue or white at the base, with a bright yellow stripe ventrally, tube narrow, strongly curved, lower lip expanded, upper lip slightly reflexed, glabrous at the base, then finely eglandular hairy, the base of the upper lobes and of the ventral lobe with a dense glandular indumentum, the lobes sparsely glandular hairy; tube 10–13 mm long dorsally, 13–20 mm ventrally, 10–14.5 mm laterally between lips; upper lobes elliptic, 2–6 × 2–7 mm, lateral lobes obtuse, 4–6 × 5–8.5 mm, ventral lobe elliptic, 4.5–7.5 × 6–12 mm. **Stamens** arising 6–10.5 mm above the corolla base; filaments straight, with a little projection dorsally at the base of the anther, pale yellow, sparsely and minutely hairy, 2.5–3 mm long, 0.4–0.6 mm wide; anthers white, with an indumentum of long coloured hairs growing on the outer end and short white hairs growing on the inner end, 1.7–2.5 × 1.5 mm, apically joined by a connective, thecae parallel; lateral staminodes 0.7–1 mm long, arising c. 1.5–7 mm above the corolla base, central staminode 0.2–0.5 mm long, arising 3–7.5 mm above the corolla base. **Disk** annular, margin subentire, 0.3–0.7 mm high. **Pistil** c. 15–20 mm long; ovary 6–6.5 mm long, c. 1 mm diameter,

sparsely eglandular hairy or glabrescent in the bottom half, hairier towards the apex; style arising at almost a right angle to the ovary, 8.5–9.5 mm, eglandular hairy; stigma c. 0.7 mm long, glabrescent, bilobed, lobes rounded, 0.3–0.5 mm. **Fruit** and seeds not seen.

Distribution. Northern and Northeastern Thailand.

Habitat. On limestone in dry evergreen forest.

Provisional IUCN conservation assessment. Vulnerable B1ab(iii). This species is only known from a few collections and has an EOO of < 6,000 km². Not all of the localities are within protected areas. Its AOO might suggest a status of Endangered but much of the potential distribution has not been adequately explored to be confident that its AOO is within the limit.

Additional specimens examined. THAILAND: **Khon Kaen:** Choonpa [Chum Phae], 23 Nov 1963, Pradit 738 (BK). **Loei:** Phu Luang Wildlife Reserve, Nam Tok to Pa Paw trail, 29 Sep 1990, Chantaranothai, P. et al. 90/439 (BKF, K). **Phitsanulok:** Noen Maprang, Bahn Mung, Thung Salaeng Luang National Park, 85 m, 31 Aug 2008, Sreepoowiang, K. K 52 (SING); Noen Maprang, Tham Pha Tha Phon Non-Hunting Area, 9 Sep 2011, Norsaengsri, M. & Insea, R. 8188 (QBG); Noen Maprang, Tham Pha Tha Phon Wildlife Sanctuary, 17 Nov 2010, Maknoi, C. 3973 (QBG).

Notes. This species is named after Dr Naiyana Tetsana from the Forest Herbarium Bangkok, who collected and shared a number of specimens and photos of the new species described in this article. *Microchirita tetsanae* has individuals with purple-blue and cream-white flowers, sympatric in Phitsanulok. No morphological characters support a possible recognition of these as different taxa and they are treated here only as colour forms of the same species. It is also reported from Uttaradit (photos from Pranee Nangnam seen).

26. *Microchirita thailandica* C.Puglisi, sp. nov.

Species most similar to *Microchirita tetsanae* C.Puglisi in the colour pattern of the corolla, differing in having a narrower tube which widens abruptly (gradually widening in *M. tetsanae*), all corolla lobes imbricate (vs. lateral lobes not imbricate with the upper in *M. tetsanae*), a shorter ventral tube, and in not having a projection at the anther insertion. – TYPE: Thailand, Chaityaphum, Phak Dee Chumphon, Wat Thum Wua Daeng, 460 m, 8 November 2014, *Tetsana, N. et al. 904* (holotype BKF; isotype SING). (Fig. 16C–E)

Caulescent herb 10–50 cm tall, internodes 3–6 cm. **Stems** succulent, with sparse eglandular indumentum, branching from the basal petiole. **Leaves** opposite, apart from the basal leaf; petioles 0.3–0.8 cm long, sparsely eglandular hairy; blades mid

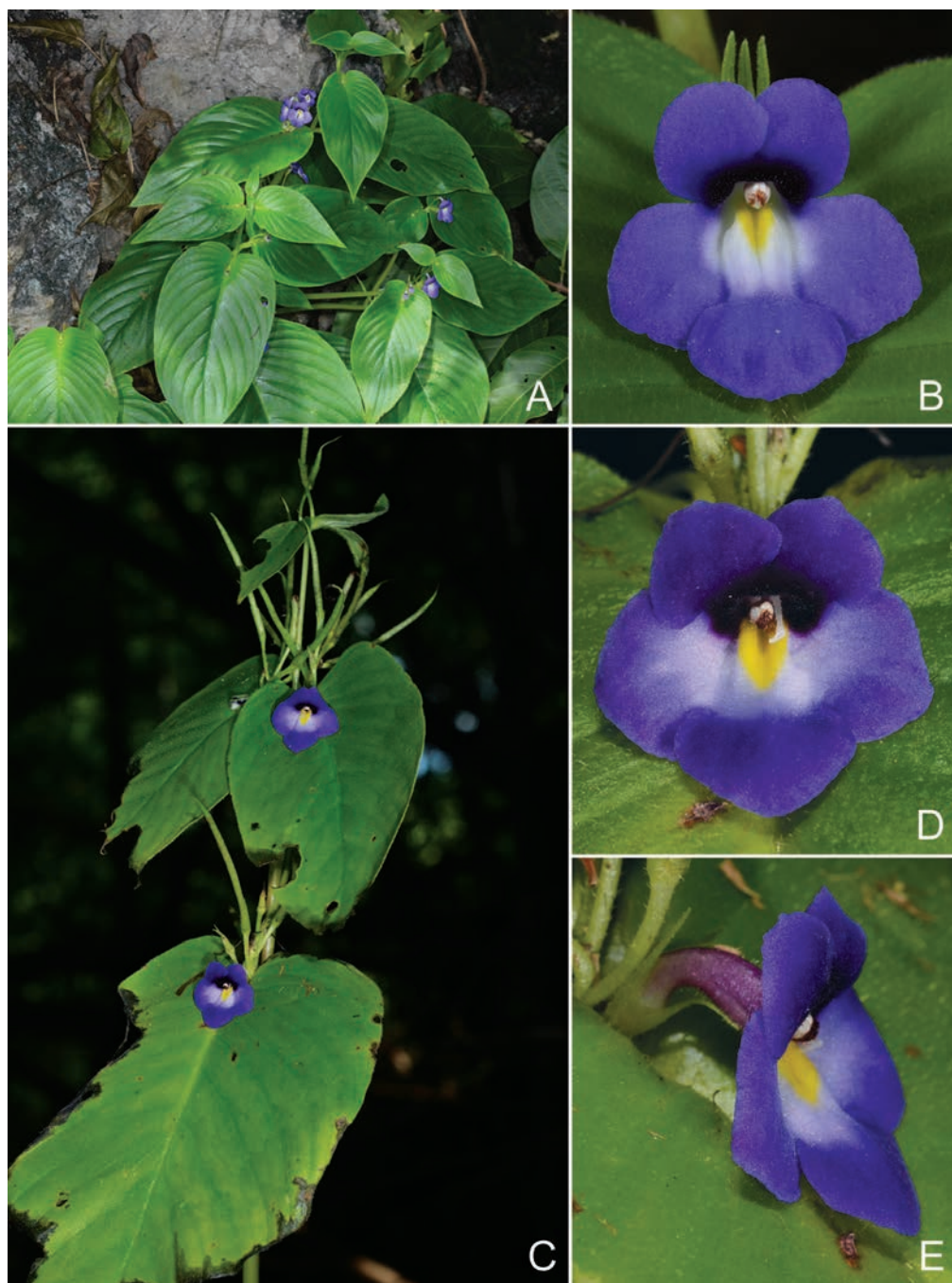


Fig. 16. *Microchirita tetsanae* C.Puglisi. **A.** Habit. **B.** Front view of the flower. All from Tetsana, N. et al. 855. *Microchirita thailandica* C.Puglisi. **C.** Habit. **D.** Front view of the flower. **E.** Lateral view of the flower. All from Tetsana, N. et al. 904. (Photos: N. Tetsana)

green above, ovate to lanceolate, $2.8\text{--}11 \times 1.5\text{--}6.8$ cm (basal leaf likely to have been larger but not seen), 1.6–1.9 times as long as wide, base truncate to shortly attenuate, apex acute to acuminate, eglandular hairy above and beneath, margin ciliate, margin entire, 7–8 pairs of secondary veins (basal leaf not seen), venation slightly sunken on the adaxial side. **Inflorescence** cristate, many-flowered, floral axes hispid with mixed eglandular and glandular hairs; peduncles extremely reduced and fused with each other; bracts absent; pedicels 2–15 mm long. **Calyx** pale green, c. 9.5 mm long, tube 5–7 mm long, lobes narrowly lanceolate, c. 8.5×1.5 mm, apex narrowly acute to acuminate, lobes not imbricate, with sparse eglandular hairs outside and an even sparser indumentum inside, mixed with sessile glands. **Corolla** c. 23 mm long, tube purple, lobes purple-blue, mouth pale blue, with a yellow ventral marking and a dark purple patch at the base of the upper lobes, tube narrow, bent downwards, abruptly widening, outer side hairy throughout, inside densely covered in eglandular hairs in the mouth and dense sessile glands over the ventral yellow spot; tube c. 13.5 mm dorsally, c. 14 mm ventrally and laterally; upper lobes c. 5.5×8.5 mm, lateral lobes c. 5.5×8 mm, ventral lobe c. 7×8 mm. **Stamens** arising c. 9 mm above the corolla base, filaments straight, c. 2 mm long, c. 0.5 mm diameter, without any projection; anthers ligate, with an indumentum of long brown hairs growing on the outer end and short white hairs growing on the inner end, c. 1.1×1.3 mm; lateral staminodes c. 1 mm long, arising c. 8 mm above the corolla base, central staminode c. 0.8 mm long, arising c. 9 mm above the corolla base. **Disk** annular, c. 0.9 mm. **Pistil** c. 13 mm long; ovary c. 8 mm long, c. 1 mm diameter, glabrous in the basal 1/3, eglandular tomentose above; style enantiostylous, c. 5 mm, eglandular hairy; stigma 0.8 mm long, densely glandular hairy, shallowly bilobed, lobes rounded, c. 0.4 mm. **Fruit** straight, sparsely eglandular hairy, 3–5 cm. **Seeds** c. 0.4×0.2 mm, brown, elliptic.

Distribution. Eastern Thailand.

Habitat. On limestone.

Provisional IUCN conservation assessment. Data Deficient (DD). This species is only known from the type locality and too little is known of its distribution or possible threats (except that the single collection was not made in a protected area).

Notes. This species has been named after the country to which it is endemic.

27. *Microchirita tubulosa* (Craib) A. Weber & D.J. Middleton, *Taxon* 60: 79 (2011). – *Chirita tubulosa* Craib, *Bull. Misc. Inform. Kew* 173 (1922); Barnett, *Fl. Siam.* 3: 227 (1962); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 190 (1974); Burt, *Thai Forest Bull., Bot.* 29: 89 (2001). – TYPE: “described from plants grown from seed collected by Kerr. Flowered in October 1921” (lectotype ABD, first step designated by Wood (1974: 190), second step designated here [the specimen which matches the image deposited in E, barcode E00155288]; isolectotypes ABD, E). (Fig. 17)

Chirita barbata auct. non Sprague: Barnett, Fl. Siam. 3: 222 (1962).

Caulescent herb to 50 cm tall, internodes 1.5–9 cm long, sometimes branches arising from the petioles. **Stem** fleshy, green or flushed red-brown, eglandular hairy. **Leaves** opposite, apart from the basal leaf; petioles green or purple-brown, 2–20 mm long; blades pale to dull green above, paler beneath, lanceolate, elliptic or ovate, $3.5\text{--}36 \times 1.4\text{--}20$ cm, 1.7–3.9 times as long as wide, base obtuse to subcordate to rarely somewhat attenuate, apex acute to acuminate, eglandular hispid above and beneath, margin ciliate, margin entire to obscurely toothed, midrib green or red-brown, 5–14 pairs of secondary veins, venation more or less sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation lax and inconspicuous. **Inflorescences** cristate, 1–8-flowered; peduncles 2–10 mm long, sometimes fused with each other; bracts absent; pedicels green, 0.5–2 cm long, eglandular hairy. All floral axes with sparse to dense eglandular hairs. **Calyx** bilabiate, green, lobes succulent along the midrib, lower tube 0.6–0.8 mm, lateral tube 0.1–0.6 mm, upper tube c. 1.2 mm, lobes imbricate, lanceolate, $11\text{--}17 \times 2\text{--}3$ mm (the dorsal wider than the lateral, which in turn are wider than the ventral), apex acute to slightly acuminate, margin entire, eglandular hairy outside on margin and midrib, glabrous inside except tip. **Corolla** 17–25 mm long, white outside on tube and lobes, creamy yellow in throat, with a yellow ventral stripe and lateral purple-brown stripes or spots, tube narrow, usually curved, becoming pouched, with upper and lateral lobes spreading, ventral lobe prominent and forming a sinus at the base where it connects with the lateral lobe, tube glabrous at the base, outside densely and minutely eglandular and glandular hairy, glabrous inside, with sessile or stalked glands all over the throat but especially dense under the upper lobes; tube 12–20 mm long dorsally, 16–22 mm ventrally, 15–20 mm between the lips; lobes with obtuse apex, upper lobes $2\text{--}4.5 \times 5\text{--}5.5$ mm, lateral lobes $4.5\text{--}6 \times 6.5\text{--}10$ mm, ventral lobe $5.5\text{--}7.5 \times$ c. 7 mm. **Stamens** arising 1.1–1.2 cm above the corolla base, filaments bent at base, $4\text{--}7 \times 0.7\text{--}1.2$ mm, yellow, glabrous; anthers white with white hairs at the top and dorsally, $3\text{--}3.3 \times 2\text{--}2.5$ mm, apically joined by a connective, thecae divergent, apiculate; staminodes absent or 2, 0.3–0.4 mm long, arising 6–7.5 mm above the corolla base. **Disk** annular or more often dorsally cleft, margin slightly lobed, 0.5–1 mm high. **Pistil** 13–20 mm long; ovary 0.9–1.2 cm long, c. 1.1 mm diameter, glabrous to minutely glandular in the bottom $1/3\text{--}1/2$, densely eglandular hairy above and with some glandular hairs between ovary and style; style 0.2–0.5 mm diameter, eglandular hairy except at the very top, 0.8–1.4 cm long; stigma broadly bilobed, lobes 1–1.3 mm, hairy. **Fruit** green, 2.5–4 cm long, 1.7–2.6 mm diameter, sparsely eglandular hairy, straight or slightly curved. **Seeds** dark brown, elliptic, acuminate, c. 0.4×0.2 mm.

Distribution. Widespread in Central, Eastern and Southeastern Thailand.

Habitat. On limestone in deciduous forest.

Provisional IUCN conservation assessment. Near Threatened NT. The EOO is $> 45,000$ km², well beyond the threshold for a Vulnerable status. The AOO, however, is



Fig. 17. *Microchirita tubulosa* (Craib) A.Weber & D.J.Middleton. **A.** Inflorescence and side view of the flower; **B.** Lateral view of the flower. **C.** Front view of a mature flower. **D.** Front view of a young flower. A, C from Middleton, D.J. *et al.* 4809; B, D from Tetsana, N. *et al* 800. (Photos: A, C, D.J. Middleton; B, D, N. Tetsana)

< 75 km², which would be within the threshold for an Endangered status except that the number of locations is too high for Endangered or Vulnerable. Nevertheless, many of the collection localities for this species are not in protected areas and the regions in which this species occurs are also where mining of limestone is particularly active.

Additional specimens examined. **Unknown locality:** “145” coll. 9 Nov 1927 (ABD [2 sheets]); Cultivated at RBG Kew, 5 Nov 1923, 418-23 (K); various specimens with no data or barcode (ABD). **THAILAND:** **Ayutthaya:** Kanam Pasak, Keng Koi, 50 m, 9 Dec 1923, *Kerr, A.F.G.* 7961 (ABD, BK, K). **Chonburi:** Sriracha, Koh Seechang Isl., 7 Nov 1969, *van Beusekom, C.F. & Smitinand, T.* 2039 (AAU, BKF, E, L, P); Sriracha, Si Chang Island, 25 m, 10 Sep 1993,

Maxwell, J.F. 93-1040 (A, BKF, CMUB, L). **Loei:** Na Dueng, Thum Pha-ya temple, 433 m, 9 Sep 2014, *Tetsana, N. et al.* 800 (SING). **Lop Buri:** 22 Oct 1926, *Smith, H.M. s.n.* (BK, K); Khao Wongkot temple, 35 m, 25 Apr 2004, *Pooma, R. et al.* 4657 (BKF); Tha Wung, Khao Samo Khon, 50 m, 14 Sep 2008, *Phonsena, P. et al.* 6245 (BK, BKF); Cultivated in Bangkok, originally from Lop Buri, 28 Sep 1930, *Kerr, A.F.G.* 19720 (ABD [2 sheets], K [2 sheets], E). **Nakhon Sawan:** Kao Sung, near Paknampo, 60 m, 9 Dec 1913, *Kerr, A.F.G.* 3019 (BM, K); Takhli, Khao Tham Phet, 50–100 m, 27 Sep 2003, *Phonsena, P. et al.* 4006 (BKF); Takli, Tahm Pet Tahm Tong Forest Park, 140 m, 15 Oct 2006, *van de Bult, M.* 913 (BKF, CMUB); Ban Takli, 22 Oct 1929, *Put, N.* “224” (ABD); Cultivated in Aberdeen, 1931, “*Kerr*” 224 (ABD, L, US); Ban Phot Phisai, Wat Thep Satha Phon, 50 m, 8 Sep 2009, *Middleton, D.J. & Triboun, P.* 4809 (BKF, E, P); Banphot Phisai, Ban Daen, Khao Huai Lung, 100 m, 5 Sep 2011, *Pooma, R. et al.* 7761 (BKF); Banphot Phisai, Ban Daen, 100 m, 5 Sep 2011, *Pooma, R. et al.* 7761A (BKF); Kao Sang, Ban Den, c. 100 m, 8 Nov 1920, *Kerr, A.F.G.* 4542 (ABD, BK, BM, K); Cultivated at RBGE from Kerr 4542, 1921 (E). **Saraburi:** Chalerm Phrakiet, Na Phralan, Tham Sriwilai Temple, 100 m, 9 Sep 2006, *Pooma, R. & Phattarahirankanok, K.* 6313 (AAU, BKF, E, SING, QBG); Na Pra Larn, Khao Talu, 100–400 m, 6 Oct 1979, *Shimizu, T. et al.* T-17989 (BKF); Na Pra Larn, Khao Talu, 100–400 m, 6 Oct 1979, *Shimizu, T. et al.* T-17988 (BKF); Na Pra Larn, Khao Talu, 100–400 m, 6 Oct 1979, *Shimizu, T. et al.* T-18023 (BKF, L); Tum Sri Ni Lai, 11 Sep 2006, *Triboun, P.* 3649 (E); Kaeng Khoi, Wat Thamcharoen, 8 Sep 2006, *Pooma, R. et al.* 6279 (AAU, BKF, E, KEP, QBG); Kaeng Khoi, Tharn Pra Photisat, 100–200 m, 7 Oct 1979, *Shimizu, T. et al.* T-19417 (BKF, L); Kaeng Khoi, Tharn Pra Photisat, 7 Oct 1979, *Shimizu, T. et al.* T-19464 (BKF); Hin Lap, c. 100 m, 3 Sep 1924, *Kerr, A.F.G.* 9127 (BK, BM, K); Hin Lap, 19 Aug 1929, *Put, N.* 2410 (ABD, BK, K); Tham Pha Photisat, Hin Lap, 100 m, 26 Sep 1979, *Smitinand, T. s.n.* (BKF); Kang Koi, 11 Oct 1926, *Lakshnakara, M.C.* 287 (ABD, BK, K); Phraphuttabat, Wat Khaowong, 18 Sep 2004, *Pooma, R. et al.* 4820 (BKF); Ban Nawng Bua, 1 Oct 1927, *Put, N.* 1116 (ABD*, BK, K *an ABD specimen is a mixed collection of *Microchirita tubulosa* and *M. marcanii*); Phu Khae, Chong Khao Khad, Bencha Khiri Temple, 20 m, *Suddee, S. et al.* 3341 (BKF); Muak Lek, 300 m, 2 Oct 1963, *Smitinand, T. & Sleumer, H.O.* 1317 (BKF, E, K, L, SING); Muak Lek, 300 m, 11 Nov 1934, *Marcen, A.* 1885 (ABD, K).

Notes. Several specimens in ABD have no label data and could be original material. *Microchirita tubulosa* is characterised by a white corolla with a ventral yellow stripe and lateral purple markings (blotches or stripes; if stripes, sometimes multiple on each side). It is most similar to *Microchirita marcanii* and *M. luteola* (see discussion under each), but differs in the corolla colour pattern and the smaller flower.

28. *Microchirita viola* (Ridl.) A.Weber & Rafidah, *Taxon* 60: 779 (2011); Rafidah, *Gard. Bull. Singapore* 69: 26 (2017). – *Chirita viola* Ridl., *J. Linn. Soc., Bot.* 32: 516 (1896); Barnett, *Fl. Siam.* 3: 228 (1962); Wood, *Notes Roy. Bot. Gard. Edinburgh* 33: 190 (1974); Burt, *Thai Forest Bull., Bot.* 29: 89 (2001). – *Didymocarpus viola* (Ridl.) Williams, *Bull. Herb. Boiss. Ser. 2*, 5: 434 (1905). – TYPE: Malaysia, Peninsular Malaysia, Kedah, Langkawi, September 1890, *Curtis* 2570 (lectotype SING [SING0042993], designated by Rafidah (2017: 26); isolectotypes SING [SING0042994, SING0042995]). (Fig. 18A–B)

Caulescent perennial herb to 40 cm tall, internodes 1–10 cm, occasionally branching from the basal portion of the basal petiole. **Stems** purple or green, strigose, more densely so at the nodes. **Leaves** opposite; petioles 2–10 mm long, c. 1.5 mm diameter, strigose; blades elliptic to lanceolate, green above, pale green beneath, $2.1\text{--}15 \times 1.6\text{--}8.4$ cm, 1.1–2.3 times as long as wide, base shortly attenuate to rounded to subcordate, apex acute, eglandular tomentose above, hispid beneath, ciliate along the margin, margin entire (can be serrate in some Malaysian specimens), 6–11 pairs of secondary veins in the opposite leaves, venation slightly sunken above and raised beneath in fresh material, tertiary venation lax and seldom visible. **Inflorescence** cristate, 1–6-flowered; peduncles reduced; bracts absent; pedicels 7–20 mm long, eglandular hairy. **Calyx** green, succulent at the base, lobes almost free to base, narrowly lanceolate, c. $6\text{--}10 \times$ c. 1 mm, apex narrowly acute, outside eglandular hairy, inside with sparse hairs becoming denser at the tip. **Corolla** 17–21 mm long, tube yellowish white inside, lobes blue-purple with dark blue lines, tube narrow at base, bent downwards, then gradually expanding, with sessile glands inside, elongated glands at the base of the upper lobes and very minute glandular hairs on the lower lip; tube 13 mm long dorsally, 16 mm ventrally, 12 mm laterally between lips; upper lobes c. 2.5×4 mm, lateral lobes, c. 3.5×4.3 mm, lower lobe c. 5×4.5 mm. **Stamens** arising c. 8.5 mm above the corolla base; filaments straight, glabrous, c. 3 mm long, c. 0.3 mm wide; anthers sparsely hairy dorsally, c. 2×1 mm, apically coherent but not joined by a connective, thecae divergent; lateral staminodes c. 1.2 mm long, central staminode not seen. **Disk** annular, margin slightly lobate, c. 0.3 mm high. **Pistil** c. 14 mm long, densely eglandular hairy throughout except at the base of the ovary; ovary c. 5.5 mm long, c. 0.6 mm diameter; style c. 6.5 mm; stigma deeply bilobed, lobes c. 0.9×0.4 mm, shortly plumose inside. **Fruit** 1–4.5 cm long, 0.9–1 mm diameter, densely eglandular hairy, straight or slightly curved. **Seeds** brown, broadly elliptic, $0.4\text{--}0.5 \times 0.2\text{--}0.3$ mm.

Distribution. Peninsular Thailand. Malaysia.

Habitat. On limestone in evergreen forest.

Provisional IUCN conservation assessment. Vulnerable VU B1ab(iii). This species occurs on Langkawi in Malaysia and has also previously been collected on the mainland in Kedah. Rafidah (2017) reports that no recent collections have been made from the Kedah mainland and suggests a conservation assessment of Near Threatened as the species is reported to be common and protected on Langkawi. In Thailand, however, most of the known localities are not in protected areas and are subject to high disturbance. The EOO and number of collection localities, coupled with these threats, suggest an assessment of Vulnerable.

Additional specimens examined. THAILAND: **Krabi:** Ao Luek, c. 50 m, 17 Nov 1959, Smitinand, T. & Abbe, E.C. 6151 (BKF, K (2)); Muang, Krabi Noi, Wat Tham Suea, 25 m, 17 Sep 2010, Middleton, D.J. et al. 5467 (E); Kasoom, Nov 1896, Curtis 3221 (K). **Phangnga:** s.l., 28 Feb 1929, Kerr 17563 (K); Mueang Phangnga, Sri Nakharin Park, 1 m, 18 Nov 2014,

Suddee, S. et al. 4807 (BKF); Thap Put, Kee Ree Wong Temple, 24 Oct 2004, *Saway & Rob.* 11138 (QBG).

Notes. *Microchirita viola* is represented by rather few specimens in Thailand. A more comprehensive description of this species is provided by Rafidah (2017).

29. *Microchirita woodii* D.J.Middleton & Triboun, Thai Forest Bull., Bot. 41: 15 (2013). – TYPE: Thailand, Nan, Muang Nan, Tham Pha Tup Forest Park, trail to Phra Cave, 300 m alt., 16 August 2012, *Middleton, D.J., Karaket, P., Suddee, S. & Triboun, P.* 5612 (holotype BKF; isotypes BK, E [00629450], P [P00966763]). (Fig. 18C–F)

Caulescent herb to 50 cm tall with elongated stem runners, internodes 2–15 cm. **Stems** succulent, green, glabrescent or with a sparse eglandular indumentum. **Leaves** opposite, apart from the basal leaf; petioles 0.3–1 cm long, green, sparsely eglandular hairy; blades pale green above and beneath, ovate to elliptic, $2.7\text{--}30 \times 1.8\text{--}21.5$ cm, 1.2–2.2 times as long as wide, base cordate, apex acute, sparsely eglandular hairy above and beneath, ciliate along the margin, margin entire with sparse obscure teeth, 8–15 pairs of secondary veins, venation sunken above and raised beneath in fresh material, flat in dry specimens, tertiary venation laxly reticulate. **Inflorescences** cristate, peduncles reduced or emerging to 5 mm long but not fused together, bracts absent; pedicels pale green, 7–20 mm long, pubescent. **Calyx** green, actinomorphic, lobes completely divided, narrowly ovate, $5.7\text{--}10.5 \times 0.9\text{--}1$ mm, apex acuminate and slightly thickened, margin entire, glabrescent or sparsely hairy, hairier at tip, glabrous inside. **Corolla** 18–22 mm long, tube very pale green, lobes yellow-white, throat yellow with a darker yellow ventral patch and dark brown spots to its sides, tube narrow, curved, then widening gradually, lobes somewhat spreading, eglandular hairy outside, inside with glandular hairs at the base of the upper lobes and dorsally in the tube; tube 12.5–15.5 mm long dorsally, 15.9–19.5 mm ventrally, c. 15 mm laterally between lips; lobes broadly orbicular to ovate, apices rounded, upper lobes $3\text{--}4.2 \times 4\text{--}6.6$ mm, lateral lobes $4.5\text{--}5.7 \times 5.5\text{--}7$ mm, ventral lobe $5\text{--}7.5 \times 6.2\text{--}8$ mm. **Stamens** arising 9–11.2 mm above the corolla base, filaments straight, glabrous, 2–2.5 mm long, 0.4 mm wide; anthers white, with a dimorphic indumentum of long brown hairs above dorsally and short white hairs below, $1.9\text{--}2.2 \times 1.3\text{--}1.8$ mm, apically joined by a connective, thecae more or less parallel; staminodes reduced, c. 0.2 mm long. **Disk** annular, 0.4–0.8 mm high. **Pistil** c. 12 mm long; ovary 5.5–7.5 mm long, c. 1.2 mm diameter, papillose at the base, pubescent above; style 6–7.5 mm long, pubescent; stigma c. 0.8 mm long. **Fruit** green, to 7 cm long, 0.8–1.2 mm diameter, eglandular hairy or glabrescent, straight or slightly curved. **Seeds** maroon, narrowly elliptic, acuminate $0.3\text{--}0.5 \times 0.1\text{--}0.2$ mm.

Distribution. Northern Thailand (Nan).

Habitat. On limestone in evergreen forest.

Provisional IUCN conservation assessment. Data Deficient (DD). *Microchirita woodii*

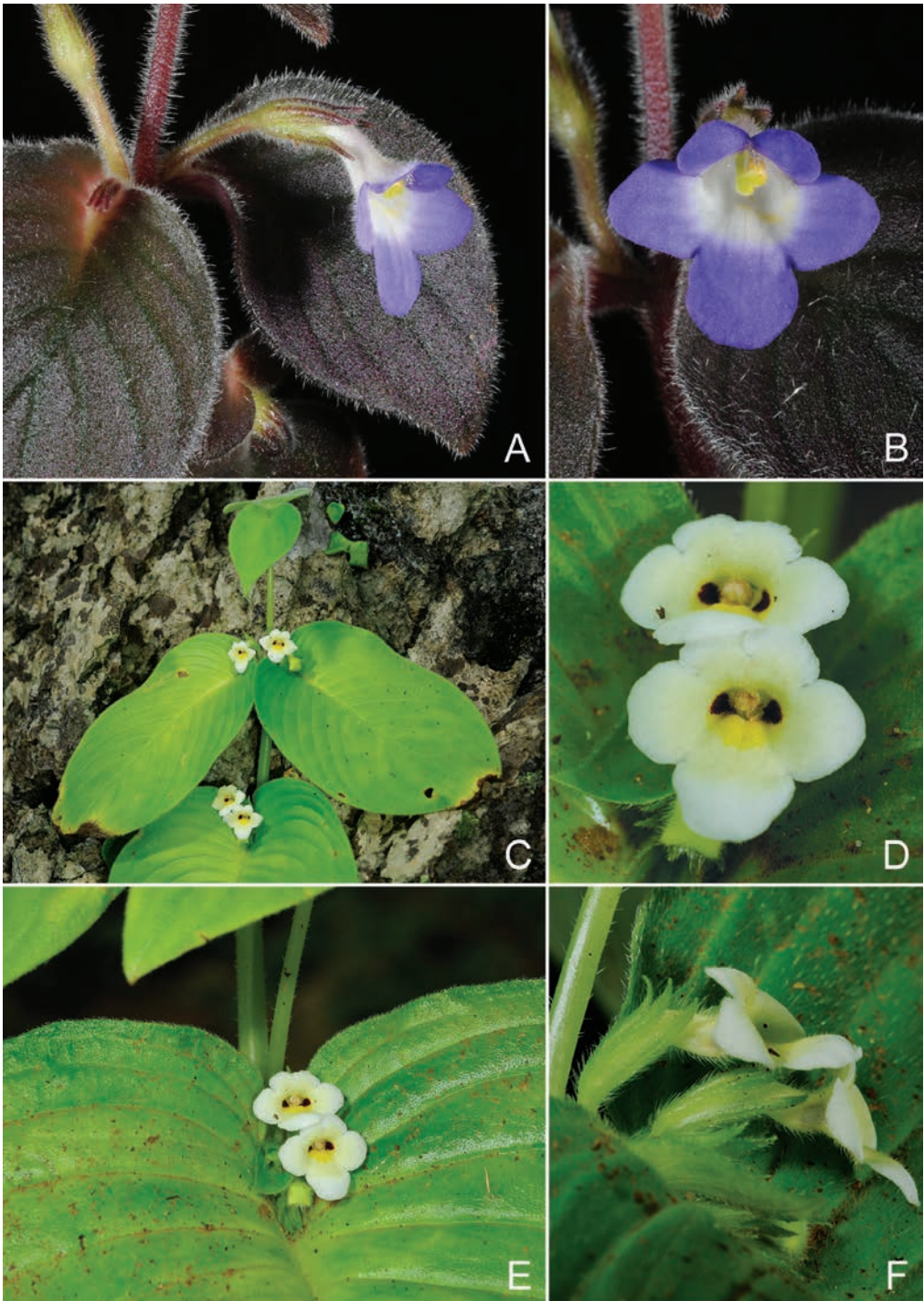


Fig. 18. *Microchirita viola* (Ridl.) A. Weber & Rafidah. **A.** Lateral view of the flower. **B.** Front view of the flower. All from Middleton, D.J. et al. 5467. *Microchirita woodii* D.J. Middleton & Triboun. **C.** Habit. **D.** Front view of the flower. **E.** Inflorescence. **F.** Side view of the flower. All from Middleton, D.J. et al. 5612. (Photos: A, B, D.J. Middleton; C–F, P. Karaket)

is only known from Tham Pha Tup Forest Park which is less than 1 km² in size and subject to disturbance from tourism. However, there have been far fewer collections made in other forested areas to the north and until it can be assessed whether this species also occurs there, its conservation status is uncertain.

Additional specimens examined. THAILAND: **Nan:** Tham Pha Toop Forest Park, 230 m, 2 Sep 1999, *Middleton, D.J.* 148 (BKF); Tham Pa Tok, 350 m, 13 Sep 1995, *Larsen, K. et al.* (AAU, BKF, SING); Mueang Nan, Tham Pha Toop, 400 m, 18 Sep 1999, *Srisanga, P. & Puff, C.* 1110 (BKF, E, QBG); Muang, Taam Paa Toop, c. 300 m, 13 Sep 1995, *Nanakorn, W. et al.* 4236 (E, QBG).

Notes. This species is recognisable by the colour pattern of the corolla which is pale yellow-white with dark reddish-brown spots, and the dimorphic anther indumentum. The other pale-coloured species with markings are *M. huppataensis*, from which *M. woodii* differs in the slightly compressed corolla mouth and the dimorphic anther indumentum, and *M. karaketii*, which has violet markings and differs in the shape of the corolla (more slender). In central and eastern Thailand, *M. tubulosa* has a similar colour pattern, but its corolla is much larger and a very different shape.

Incertae sedis

The following specimens could not be determined to species for a variety of reasons, either because the material was sterile or otherwise too poor to identify, or because the specimen may be of an undescribed taxon but the material inadequate to describe.

Khon Kaen: Pa Potiyan, 17 Dec 1963, *Youngboonkird, U.* 129 (BK); Phuphaman NP, 300 m, 24 Aug 2011, *Norsaengsri, M. et al.* 8086 (QBG).

Loei: Phu Kradueng, Maholan Cave, 370 m, 17 Dec 1982, *Koyama, H. et al.* T-31171 (BKF).

Mukdahan: Mueang, Phu Pha Thoep National Park, 175 m, 25 Oct 2015, *Suddee, S. et al.* 4989 (BKF).

Sakon Nakhon: Phu Pha Man National Park, Laan Sao La to Pha Nang Maen, 14 Oct 1990, *Chantharanothai, P. & Parnell, J.* 90/704 (K).

Saraburi: Phraphutthabath, Khunkhol Tham Makak, 50 m, 20 Nov 2005, *Pooma, R. et al.* 5719 (E); Phraphutthabath, 22 Sep 1999, *Wongprasert, T. s.n.* (BKF).

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References

- Applequist, W.L. (2016). Report of the Nomenclature Committee for Vascular Plants: 68. *Taxon* 65: 1153–1165.
- Burt, B.L. (1954). Studies in the Gesneriaceae of the Old World II. *Notes Roy. Bot. Gard. Edinburgh* 21: 193–208.
- Burt, B.L. (1960). A new *Chirita* from Thailand. *J. Roy. Hort. Soc.* 85: 27–28.
- Burt, B.L. (2001). Flora of Thailand: Annotated checklist of Gesneriaceae. *Thai Forest Bull., Bot.* 29: 81–109.
- Craib, W.G. (1926). Contributions to the Flora of Siam. Additamentum XVIII. *Bull. Misc. Inform. Kew*: 154–174.
- Craib, W.G. (1930). Contributions to the Flora of Siam. Additamentum XXVII. *Bull. Misc. Inform. Kew*: 161–174.
- Hilliard, O.M. (2004). A revision of *Chirita* sect. *Liebigia* (Gesneriaceae). *Edinburgh J. Bot.* 60: 361–387.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*, 2nd ed. Gland, Switzerland and Cambridge, UK: IUCN.
- Middleton, D.J. & Möller, M. (2012). *Tribounia*, a new genus of Gesneriaceae from Thailand. *Taxon* 61: 1286–1295.
- Middleton, D.J. & Puglisi, C. (2015). Proposal to conserve the name *Chirita hamosa* (*Microchirita hamosa*) (Gesneriaceae) with a conserved type. *Taxon* 64: 1328–1329.
- Middleton, D.J. & Triboun, P. (2012). *Somrania*, a new genus of Gesneriaceae from Thailand. *Thai Forest Bull., Bot.* 40: 9–13.
- Middleton, D.J. & Triboun, P. (2013). New species of *Microchirita* (Gesneriaceae) from Thailand. *Thai Forest Bull., Bot.* 41: 13–22.
- Middleton, D.J., Atkins, H., Truong, L.H., Nishii, K. & Möller, M. (2014). *Billolivia*, a new genus of Gesneriaceae from Vietnam with five new species. *Phytotaxa* 161: 241–269.
- Middleton, D.J., Nishii, K., Puglisi, C., Forrest, L. & Möller, M. (2015). *Chayamaritia* (Gesneriaceae: Didymocarpoideae), a new genus from Southeast Asia. *Pl. Syst. Evol.* 301(7): 1947–1966.
- Möller, M., Forrest, A., Wei, Y.G. & Weber, A. (2011). A molecular phylogenetic assessment of the advanced Asiatic and Malesian didymocarpoid Gesneriaceae with focus on nonmonophyletic and monotypic genera. *Pl. Syst. Evol.* 292(3–4): 223–248.
- Möller, M., Chen, W.H., Shui, Y.M., Atkins, H.J. & Middleton, D.J. (2014). A new genus of Gesneriaceae in China and the transfer of *Briggsia* species to other genera. *Gard. Bull. Singapore* 66(2): 195–205.
- Möller, M., Nishii, K., Atkins, H.J., Kong, H.H., Kang, M., Wei, Y.G., Wen, F., Hong, X. & Middleton, D.J. (2016). An expansion of the genus *Deinostigma* (Gesneriaceae). *Gard. Bull. Singapore* 68(1): 145–172.
- Puglisi, C. & Middleton, D.J. (2017). A revision of *Damrongia* (Gesneriaceae) in Thailand. *Thai Forest Bull., Bot.* 45: 79–93.

- Puglisi, C., Middleton, D.J., Triboun, P. & Möller, M. (2011). New insights into the relationships between *Paraboea*, *Trisepalum* and *Phylloboea* (Gesneriaceae) and their taxonomic consequences. *Taxon* 60: 1693–1702.
- Puglisi, C., Yao, T.L., Milne, R., Möller, M., & Middleton, D.J. (2016). Generic recircumscription in the Loxocarpaceae (Gesneriaceae), as inferred by phylogenetic and morphological data. *Taxon* 65: 277–292.
- Punekar, S.A. & Lakshminarasimhan, P. (2009). *Chirita sahyadriensis* (Gesneriaceae), a new species from Western Ghats, India. *Folia Malaysiana* 10: 17–22.
- Rafidah, A.R. (2017). Taxonomy and conservation status of *Microchirita* (Gesneriaceae) in Peninsular Malaysia. *Gard. Bull. Singapore* 69: 1–31.
- Rafidah, A.R. & Haron, N.W. (2013). *Microchirita ruthiae* sp. nov. (Gesneriaceae) from Peninsular Malaysia. *Nord. J. Bot.* 31: 612–615.
- Rafidah, A.R., Kiew, R. & Haron, N.W. 2011. To which genus does the enigmatic Peninsular Malaysia *Chirita elata* (Gesneriaceae) belong? *Blumea* 56: 18–20.
- Thiers, B. (2017, continuously updated). *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>. Accessed 12 July 2017.
- Wang, Y.-Z., Mao, R.-B., Liu, Y., Li, J.-M., Dong, Y., Li, Z.-Y. & Smith, J. (2011). Phylogenetic reconstruction of *Chirita* and allies (Gesneriaceae) with taxonomic treatments. *J. Syst. Evol.* 49: 50–64.
- Weber, A. (1975). The cristate inflorescence of *Chirita* sect. *Microchirita* (Gesneriaceae). *Notes Roy. Bot. Gard. Edinburgh* 34: 221–230.
- Weber, A., Middleton, D.J., Forrest, A., Kiew, R., Lim, C.L., Rafidah, A., Triboun, P., Wei, Y.G., Yao, T.L., Sontag, S. & Möller, M. (2011a). Molecular systematics and remodelling of *Chirita* and associated genera (Gesneriaceae). *Taxon* 60: 767–790.
- Weber, A., Wei, Y.G., Puglisi, C., Mayer, V. & Möller, M. (2011b). A new definition of the genus *Petrocodon* (Gesneriaceae). *Phytotaxa* 23: 49–67.
- Wei, Y.G., Fang, W., Chen, W.H., Shui, Y.M. & Möller, M. (2010). *Litostigma*, a new genus from China: A morphological link between basal and derived didymocarpoid Gesneriaceae. *Edinburgh J. Bot.* 67: 161–184.
- Wood, D. (1972). Studies in the Gesneriaceae of the Old World XXXV: new species and combination in *Chirita*. *Notes Roy. Bot. Gard. Edinburgh* 31: 367–371.
- Wood, D. (1974). A revision of *Chirita* (Gesneriaceae). *Notes Roy. Bot. Gard. Edinburgh* 33: 123–205.