THAI FOREST BULL., BOT. 49(2): 173–177. 2021.
DOI https://doi.org/10.20531/tfb.2021.49.2.03

The genus *Phyllocyclus* (Gentianaceae) in Thailand

KOTCHAPHAN SISAKHON[1], KONGKANDA CHAYAMARIT[2], NARONG WONGKANTRAKORN[1], DAVID. J. MIDDLETON[3], WITTAWAT KIEWBANG[4], WATCHARA SALEE[5] & SRUNYA VAJRODAYA[1,*]

ABSTRACT

An account of the genus *Phyllocyclus* (Gentianaceae) for Thailand is presented. Three species are recognized, including two recently reported species, *Phyllocyclus petelotii* and *P. parishii*. A key to the Thai species, descriptions, illustrations, and conservation status are provided.

KEYWORDS: *Canscora*, conservation status, Flora of Thailand, taxonomy.

Accepted for publication: 3 August 2021. Published online: 10 September 2021

INTRODUCTION

The genus *Phyllocyclus* Kurz (Gentianaceae) comprises five species distributed in Southern China, Laos, Myanmar, Thailand and Vietnam (Thiv, 2003). The genus was first described by Kurz (1873) but was later reduced to *Canscora* Lam. subgenus *Phyllocyclus* by Clarke (1885). For Thailand, Ubolcholaket (1987) recognized seven species of *Canscora* Lam. in the Flora of Thailand, including a species in the *Phyllocyclus* group. A morphological cladistic analysis by Thiv & Kadereit (2002) and a molecular phylogenetic study by Struwe *et al.* (2002) both led to the conclusion that *Canscora* is not monophyletic and suggested that *Phyllocyclus* be treated at generic rank. Thiv (2003), therefore, treated *Phyllocyclus* as a distinct genus with the five species *P. helferianus* Kurz, *P. lucidissimus* (H.Lév. & Vaniot) Thiv, *P. petelotii* (Merr.) Thiv, *P. parishii* (Hook.f.) Kurz, and a new species *P. minutiflorus* Thiv. Of these species, only one was recognized in the Flora of Thailand account, *P. helferianus*. Hul (2003) reported one species, *P. petelotii*, for the Flora of Laos, Cambodge and Vietnam and reduced *P. minutiflorus* to synonymy of this species. She also included Thailand in its distribution but without citing specimens. Two species of *Phyllocyclus* were listed for Thailand in the revised version of Thai Plant Names book (Pooma & Suddee, 2014), *P. helferianus* and *P. parishii*. In this paper, we clarify which species are in Thailand and present an account of *Phyllocyclus* for the Flora of Thailand with a total of three species.

MATERIALS & METHODS

Materials were examined from herbarium specimens at AAU, BK, BKF, CMUB, K, KKU, L, P, PSU, QBG and SING and additional specimens from recent field collections. Digital images of type specimens available online were also studied.

TAXONOMIC TREATMENT

PHYLLOCYCLUS

Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42(4): 235. 1874; Thiv, Blumea 48(1): 33. 2003; Hul, Fl.

[1] Department of Botany, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand.

[2] Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Bangkok 10900, Thailand.

[3] Singapore Botanic Gardens, National Parks Board, 1 Cluny Road, Singapore 259569.

[4] Forest Economics Bureau, Royal Forest Department, 61 Phahonyothin Road, Ladyao, Chatuchak, Bangkok 10900, Thailand.

[5] Office of National Park, Department of National Parks, Wildlife and Plant Conservation, Bangkok 10900, Thailand.

* Corresponding author: fscisyv@ku.ac.th

Cambodge, Laos & Vietnam 31: 86. 2003.— *Canscora* Lam, Encycl. 1: 601. 1785, *pro parte*; Ubolcholaket, Flora of Thailand 5(1): 73. 1987, *pro parte*. Type species: *Phyllocyclus helferiana* Kurz.

Annual herbs, stems branched, terete, glabrous. *Lower cauline leaves* usually opposite, free; upper cauline leaves perfoliate, orbicular, with several main veins, apex obtuse. *Inflorescences* axillary, cymose, few- to many-flowered; bracts foliaceous. *Flowers* sessile or with short pedicels; calyx tubular, urceolate or inflated urceolate, not winged, with 4 or 5 short lobes, persistent; corolla funnelform or salverform, lobes 4 or 5; stamens 4 or 5, inserted around the middle of corolla tube; filaments unequal, broadened at the base; anthers 2-locular, sagittate. *Ovary* 1-locule, superior; ovules numerous with parietal placentas; stigmatic lobes rounded. *Fruit* a capsule. *Seeds* numerous, irregular in shape.

A genus of five species distributed in Southern China, Myanmar, Laos and Vietnam. Three species in Thailand.

Notes.— According to Thiv (2003), the genus is closely related to *Microrphium* C.B.Clarke and *Duplipetala* Thiv which all have stamens inserted at the same level and of equal size. It is clearly distinct from other genera in its perfoliate, orbicular cauline leaves, filaments broadened at the base and calyx venation not reticulate.

KEY TO THE SPECIES

1. Flowers mostly in dichasia, with minute prophylls, 5-merous; calyx tubular **3. P. petelotii**
1. Flowers mostly in monochasia, without minute prophylls, 4–5-merous; calyx urceolate or inflated urceolate
  2. Flowers 4-merous; corolla < 10 mm long; calyx inflated urceolate **1. P. helferianus**
  2. Flowers 5-merous; corolla > 10 mm long; calyx urceolate **2. P. parishii**

1. Phyllocyclus helferianus Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42: 235. 1873.— *Canscora helferiana* (Kurz) Wall. ex C.B.Clarke, J. Linn. Soc., Bot. 14: 432. 1875. Type: *Helfer 5816* (lectotype **K** [K000857055] image seen], designated by Thiv (2003); isolectotypes **GH** (not seen), **P** [P00347968] (image seen), [Myanmar], Tenasserim, Three Pagodas Pass, 1837. Fig. 1A–B.

Annual herbs 5–45 cm tall. *Leaves*: lower cauline leaves broadly ovate, 1.5 × 0.5 cm, early deciduous, apex cuspidate; upper cauline leaves 0.5–4.5 × 0.5–3 cm. *Inflorescences* mostly monochasia with 1–15 flowers; bracts 0.5–1 × 0.5–3 cm; without small prophylls. *Flowers* 4-merous, without minute prophylls, sessile. *Calyx* inflated urceolate, smooth or slightly keeled, 5–10 × 4–5 mm; tube 5–10 mm long; lobes triangular, 1 × 1.5 mm, apex acute. *Corolla* cream-coloured to yellow-white, ca 10 mm long; lobes slightly spathulate, apex obtuse, 1–2.5 × 0.5–1 mm. *Stamens*: filaments 2.2–2.3 mm long; anthers ca 1 × 0.4 mm. *Ovary* 2.9–4.5 × 1.1–3 mm, with an apical annulus, constricted; style up to 5.5 mm long; stigmatic lobes ca 0.3 × 0.4 mm. *Capsule* oblong, ca 4 × 3 mm.

Thailand.— NORTHERN: Mae Hong Son [10 Sept. 1974, *Larsen & Larsen KL 34343* (**AAU**, **BKF**); Mae Sariang, 11 Sept. 1999, *Srisanga & Puff 1049* (**QBG**); Wat Tham Pra, 20 Oct. 2014, *Middleton et al. 5793* (**AAU**, **BKF**, **SING**)]; Chiang Mai [Chiang Dao, 20 Nov. 1963, *Adisai 698* (**BK**); Doi Chiang Dao, 30 Nov. 1963, *Bunchorai 1385* (**BKF**); Doi Sang Liang,7 Nov. 1997, *Maxwell 97-1308* (**CMUB**)]; Tak [Road from Mae Sariang-Tha Song Yang, 27 July 2003, *Saensouk 135* (**KKU**); Road site, Tha Song Yang-Mae Sa-riang, 22 Mar. 2006, *Pooma et al. 6245* (**BKF**); Doi Huamot, 28 May 2011, *Pooma et al. 7046* (**BKF**)]. SOUTH-WESTERN: Kanchanaburi [Tapoh, *Larsen & Smitinand 9214* (**BKF**); Ta Kanum, 20 Jan. 1926, *Kerr 10278* (**BK**, **BM**, **K**, **L**); Sai Yok, 23 Feb. 1926, *Kerr 10550* (**BK**, **BM**, **K**, **L**); Khao Laem, 29 Nov. 1982, *Koyama et al. T-30448* (**BKF**); Khao Laem, 30 Nov. 1982, *Niyomdhom 436* (**BKF**); Vachiralongkorn Dam, 9 Nov. 2007, *Norsaengsri 2889* (**QBG**); Sangkhla Buri along road to three Pagodas, 4 Nov. 2019, *Hemrat Kanchanaburi-03* (**BKF**)].

Distribution.— Myanmar.

Ecology.— Dry evergreen forest, dry deciduous dipterocarp forest on degraded limestone hill, mixed deciduous forest on limestone outcrop, on limestone or rocks 100–1,200 m alt. Flowering September–February.

Vernacular.— Prakai chat nu (ประกายฉัตรหนู) (General).

Provisional National IUCN Conservation Assessment.— This species is known from lower Myanmar and northern and south-western Thailand with an Extent of Occurrence (EOO) of less than 46,643.118 km^2, and an estimated known Area of Occupancy (AOO) of around 24 km^2. It is assessed here as Near Threatened (NT) using the criteria of the IUCN Standards and Petitions Committee (2021).

2. Phyllocyclus parishii (Hook.f.) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42: 236. 1873.— *Canscora parishii* Hook.f., Bot. Mag. 90: t. 5429. 1864. Type: *Parish s.n.* (lectotype **K** [K000857053] image seen, designated here; isolectotypes **E** (not seen), **GH** [00104486] image seen, **P** [P00347969] image seen), [Myanmar], Moulmein, limestone rocks, 1862. Fig. 1C–D.

Annual herbs 10–50 cm tall. *Leaves*: lower leaves 0.5–5 × 0.5–5.5 cm; cauline leaves 0.5–4.5 × 0.5–5.5 cm. *Inflorescences* monochasia with 4–10 flowers; bracts 0.5–2 × 1–2.5 cm; without small prophylls. *Flowers* 5-merous, without minute prophylls; pedicels up to 2 mm long. *Calyx* urceolate, 5–10 × 1–2 mm; tube 1–2 cm long; lobes triangular, 3 × 2 mm, apex acute. *Corolla* white or pale yellow, 10–20 mm long; lobes spathulate, 4–5 × 4–5.5 mm, apex obtuse. *Stamens*: filaments 2–7 mm long; anthers ca 3 × 0.6 mm. *Ovary* ca 4.5 × 2 mm, with an apical annulus, striate; style up to 7 mm long; stigmatic lobes ca 0.8 × 0.6 mm. *Capsule* oblong, ca 6 × 3 mm.

Thailand — NORTHERN: Tak [Tha Song Yang, 22 Nov. 2005, *Pooma et al. 5794* (**BKF**); Doi Huamot, 28 May 2011, *Pooma et al. 7046* (**BKF**); Mae Ta Wo Ranger Unit areas, 6 Nov. 2011, *Pooma et al. 7542* (**BKF**); Mae Moei National Park, Mae Usu Cave, 19 Oct. 2014, *Middleton et al. 5785* (**BKF**)]. SOUTH-WESTERN: Kanchanaburi [Thong Pha Phum, 20 Sept. 2011, *Sirimongkol 231* (**BKF**)].

Distribution.— Myanmar.

Ecology.— Limestone rocks, 100–400 m alt. Flowering October–December.

Vernacular.— Prakai chat (ประกายฉัตร)(General).

Notes.— We select the sheet in **K** [K000857053] as the lectotype of *Phyllocyclus parishii* because it has leaves and flowers and is the best sheet of the duplicates.

Provisional National IUCN Conservation Assessment.— This species occurs at no more than 10 locations from lower Myanmar and south-western and lower northern Thailand with an Extent of Occurrence (EOO) of less than 17,346.692 km^2, and an estimated Area of Occupancy (AOO) of 20 to 40 km^2. The quality of the habitat in the locations where it is found continues to decline. It is assessed here as Vulnerable (VU B1ab(iii) + B2ab(iii)) using the criteria of the IUCN Standards and Petitions Committee (2021).

3. Phyllocyclus petelotii (Merr.) Thiv, Blumea 48(1): 39. 2003; Hul, Fl. Cambodge, Laos & Vietnam 31: 86–87. 2003.— *Canscora petelotii* Merr., J. Arnold Arbor. 19: 63. 1938. Type: Laos, Cammuan [Khammouane] Province, village de Khouan Pha Vang, 140 m, Nov. 1930, *Pételot 4327* (holotype **NY** [00178978], image seen; isotype **P** [P00347975], image seen). Fig. 1E–H.

— *Phyllocyclus minutiflorus* Thiv, Blumea 48(1): 35 (2003). Type: Laos, Cammon [Khammouane] Province, Tham Village, 1 Dec. 1930, *Pételot 3857* (holotype **NY**, (not seen); isotypes **P** [P00347972, P00347973] image seen).

Annual erect herbs 25–30 cm tall. *Leaves*: lower cauline leaves ovate, 1.9–2 × 1.3–1.8 cm, apex acute, petiole ca 0.5 cm long; upper cauline leaves perfoliate, broadly ovate or orbicular, 0.6–1.3 × 0.8–3.2 cm. *Inflorescences* mostly dichasia, few-flowered; bracts 0.7–0.8 × 1.1–1.7 cm, glabrous; with small perfoliate prophylls. *Flowers* 5-merous; pedicels up to 2 mm long. *Calyx* cylindrical or tubular, 6–7 × 2 mm; tube 5–6 mm long; lobes triangular, ca 1.5 × 1.8 mm, apex acute. *Corolla* white or pale yellow, with a bright yellow patch at base of each petal inside, and with paler yellow markings either side of the patch, funnelform to salverform, 10–15 mm long; lobes ovate, oblong to spathulate, ca 7 × 4 mm, apex obtuse, veins visible. *Stamens*: filaments 2–7 mm long; anthers ca 0.2 × 1 mm. *Ovary* ca 3 × 2 mm, smooth; style up to 4 mm long; stigmatic lobes ca 1 × 1 mm. *Capsule* oblong, ca 5 × 3 mm.

Thailand.— NORTH-EASTERN: Nakhon Phanom [Phu Langka National Park, Wat Tham Phra, 13 Oct. 2019, *Suddee et al. 5537* (**BKF**)].

Distribution.— Laos.

Figure 1. *Phyllocyclus* spp. A–B. *P. helferianus* Kurz A. habitat and habit; B. Flowers; C–D. *P. parishii* (Hook.f.) Kurz. C. habitat and habit, D. Flowers; E–H. *P. petelotii* (Merr.) Thiv. E. habitat and habit; F. inflorescences; G. lower cauline leaves; H. flower. A–D by W. Salee, E–H by W. Kiewbang.

Ecology.— Sandstone rocks in dry evergreen forest, 150–550 m. alt. Flowering: September–December.

Vernacular.— Prakai chat phu langka (ประกายฉัตรภูลังกา)(General).

Note.— *Phyllocyclus petelotii* is similar to *P. parishii* in having 5-merous flowers and a corolla > 10 mm long, but differs in having a cylindrical or tubular calyx (vs urceolate), the flowers in dichasia (vs monochasia) and with minute perfoliate prophylls at the base and along the lateral branches (vs none) (Thiv, 2003)

Additional specimens examined.— Laos. Khammouan: Forest surrounding Nakai NBCA Area Office, in shaded limestone cliff faces, 8 Nov. 2005, *Newman et al. LAO 986* (**BKF**).

Provisional National IUCN Conservation Assessment.— This species is known only from Laos and upper areas of north-eastern Thailand, with an Extent of Occurrence (EOO) of less than 100 km^2, and an estimated known Area of Occupancy (AOO) around 5 km^2. The number of mature individuals in each subpopulation is less than 50. All subpopulations occur near caves which attract significant numbers of tourists. The increased visitor numbers in the rainy and growing season might increase disturbance and could affect the survival chances of this species. It is assessed here as Endangered (EN B1ab(iii) + B2ab(iii), D) using the criteria of the IUCN Standards and Petitions Committee (2019).

ACKNOWLEDGEMENTS

We are grateful to Somran Suddee, Pachock Puudjaa, Naiyana Tetsana, Theerawat Thananthaisong and Chandee Hemrat for collecting specimens of *Phyllocyclus petelotii*; and the curators and staff of the following herbaria for information and assistance during visits to their institutions: AAU, BK, BKF, CMUB, K, KKU, L, P, PSU, QBG and SING. This research was supported by the National Research University (NRU) and the Carlsberg Foundation.

REFERENCES

Clarke, C.B. (1885). Gentianaceae. In The Flora of British India. Vol. 4: 93–132. Reeve, London.

Hul, S. (2003). Gentianaceae. In Flore du Cambodge, du Laos et du Vietnam. Muséum National d'Histoire Naturelle, Paris.

IUCN Standards and Petitions Committee (2019). Guidelines for using the IUCN Red List Categories and Criteria. Version 14. Prepared by the Standards and Petitions Committee. Downloadable from http://www.iucnredlist.org/documents/RedListGuidelines.pdf. (Accessed on 4 January 2021).

Kurz, W.S. (1873). New Burmese plants III. The journal of the Asiatic Society of Bengal 42: 227–254.

Pooma, R. & Suddee, S. (eds)(2014). Tem Smitinand's Thai Plant Names, revised edition 2014. Office of the Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Bangkok.

Struwe, L., Kadereit, J.W., Klackenberg, J., Nilsson, S., Thiv, M., von Hagen, K.B. & Albert, V.A. (2002). Systematics, character evolution, and biogeography of Gentianaceae, including a new tribal and subtribal classification. pp. 21–309. In: L. Struwe & V.A. Albert (eds), Gentianaceae: Systematics and Natural History, Cambridge University Press, Cambridge.

Thiv, M. (2003). A taxonomic revision of *Canscora*, *Cracosna*, *Duplipetala*, *Hoppea*, *Microrphium*, *Phyllocyclus* and *Schinziella* (Gentianaceae-Canscorinae). Blumea 48(1): 1–46.

Thiv, M. & Kadereit, J.W. (2002). A morphological-cladistic analysis of Gentianaceae - Canscorinae and the evolution of anisomorphic androecia in the subtribe. Systemtic Botany 27(4): 780–788.

Ubolcholaket, A. (1987). Gentianaceae. In: T. Smitinand & K. Larsen (eds), Flora of Thailand 5(1): 72–92. Chutima Press, Bangkok.