THAI FOREST BULL., BOT. 45(1): 10–17. 2017.
DOI: 10.20531/TFB.2017.45.1.03

# A revision of *Dorcoceras* (Gesneriaceae) in Thailand

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ABSTRACT

The genus *Dorcoceras* Bunge in Thailand is revised. There are four species, including two new species, *Dorcoceras brunneum* C.Puglisi and *Dorcoceras glabrum* C.Puglisi. A key, descriptions, and proposed IUCN assessments are presented.

KEYWORDS: *Boea*, conservation assessments, new species.

Published online: 6 June 2017

## INTRODUCTION

*Dorcoceras* was described by Bunge in 1833 from a plant collected in China. It was initially included in the 'Lentibularieae', but associated nonetheless with *Boea*, the genus of Gesneriaceae in which it was synonymised a few years later (Brown, 1839 & 1840). Brown did not provide any explanation in support of this synonymisation, either in the main publication of Plantae Javanicae Rariores (Brown, 1840), nor in its preprint (Brown, 1839). Despite the meticulous work carried out by Clarke (1883) in his monograph of the Old World Gesneriaceae, the extent of the morphological variation within *Boea* was questioned only much later by Schlechter (1923). In his opinion, *Boea*, as defined by Clarke (1883), was too heterogeneous and needed to be divided into at least three natural groups: 1. the "proper" *Boea*, i.e. the species from New Guinea, the Solomon Islands and Australia, including the type *B. magellanica* Lam.; 2. the Indo-Malay species, currently ascribed to *Paraboea* (C.B.Clarke) Ridl. and *Kaisupeea* B.L.Burtt; 3. the Chinese group, for which the old generic name *Dorcoceras* was resurrected. Schlechter's work was not followed by Pellegrin (1926), who wrote a synopsis of the Indochinese Gesneriaceae with no mention of *Dorcoceras*, and by all other authors thereafter. More recently, Burtt (1984) redefined *Boea* and *Paraboea* and abandoned the traditional distinction based on the fruit (twisted in *Boea*, straight in *Paraboea*) in favour of new generic boundaries based on the type of indumentum: simple hairs in *Boea*, 'arachnoid' hairs, sometimes intermixed with branched hairs, in *Paraboea*. With this change, many species of *Boea* were transferred to *Paraboea*, a conclusion supported by the molecular phylogenetic work by Puglisi *et al.* (2011). Studies focusing on the species of *Boea* and *Paraboea* in Malaysia and Thailand, led to the establishment of the segregate genera *Emarhendia* Kiew, A.Weber & B.L.Burtt (Kiew *et al.*, 1997), *Senyumia* Kiew, A.Weber & B.L.Burtt (Kiew *et al.*, 1997) and *Kaisupeea* (Burtt, 2001). *Boea* was eventually left as a genus with two distinct groups: *Boea sensu stricto*, centred in Australasia and including the type *B. magellanica*, and a small group of species from China and the Indochinese region, including Bunge's *Dorcoceras*. Puglisi *et al.* (2016) tackled the morphological and genetic diversity observed in *Boea*, leading to the resurrection of *Dorcoceras* to accommodate the distinctive Chinese and Indochinese species with a corolla which is pale lilac, obliquely campanulate, ventricose, with reflexed upper lobes and a broad throat.

The floral characters are very stable across the genus, however species can be easily identified

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through their vegetative features and especially the indumentum. All of the species of *Dorcoceras* are rosulate and can exhibit one or more of three main types of indumentum: gland-tipped multicellular hairs, eglandular multicellular hairs (both of these hair types variable in length and thickness), and sessile glands. While the sessile glands are characteristic of and exclusive to *Dorcoceras wallichii*, the multicellular hair types can be hard to distinguish as the tips easily break off in dry specimens.

Towards a revision of the Gesneriaceae for the Flora of Thailand, the genus *Dorcoceras* in Thailand has been revised. Two new species are described.

## MATERIALS AND METHODS

Specimens of *Dorcoceras* were studied from the herbaria AAU, ABD, BK, BKF, BM, C, E, G, K, K-W, L, MO, P, QBG, SING, TI (codes from Thiers, continuously updated). Additionally, living and spirit material from the Royal Botanic Garden Edinburgh was examined. Measurements of the vegetative parts and of the fruit were taken from dry specimens, while flowers were measured, whenever possible, from fresh, pickled or rehydrated samples. Measurements should be considered accurate to 0.1 mm. Collections without GPS coordinates were georeferenced using Google Earth v. 7.1.1.1580 beta (Google Inc., 2013) or other online resources and gazetteers. Estimated AOO and EOO for the proposed IUCN assessment were calculated in Geocat (Bachman *et al.*, 2011).

## TAXONOMIC TREATMENT

**Dorcoceras** Bunge, Enum. Pl. Chin. Bor.: 128. 1833. Type species: *Dorcoceras hygrometricum* Bunge.

Rosulate herbs. *Leaves* spirally arranged (or opposite in China), petiolate or sessile; lamina with a glandular or eglandular indumentum on the abaxial surface, adaxial surface eglandular hairy or sometimes glabrous. *Inflorescence* axillary, cymose or at least ending in a cyme. *Calyx* with five sepals, almost free. *Corolla* pale purple to purple, obliquely campanulate, ventricose, with a broad throat; upper lobes reflexed. *Stamens* 2, filaments straight, anthers attached to filaments at point of thecae divergence, coherent; staminodes 3, reduced. *Ovary* glabrous or with some indumentum, unilocular with 2 parietal placentae, ovules many; stigma bilabiate or capitate. *Fruit* a twisted capsule, orthocarpic, bivalved, dehiscing longitudinally. *Seeds* small, brown and elliptic.

Six species from India, Myanmar, China, Thailand, Laos, Cambodia, Vietnam, Philippines and Indonesia. In Thailand four species.

KEY TO THE THAI SPECIES OF *DORCOCERAS*

1. Lamina glabrous adaxially; inflorescence with paired flowers along the main axis **3. D. glabrum**
1. Lamina with indumentum on the adaxial surface; inflorescence cymose throughout
  2. Sessile glands present on the abaxial leaf surface; lamina to 6 cm long **4. D. wallichii**
  2. Sessile glands absent from the abaxial leaf surface; lamina 2.3–15 cm long
    3. Rusty brown indumentum on the abaxial leaf surface; lamina 3–11 times as long as wide **1. D. brunneum**
    3. Colourless indumentum on the abaxial leaf surface; lamina 1.5–3.8 times as long as wide **2. D. geoffrayi**

**1. Dorcoceras brunneum** C.Puglisi, **sp. nov.**

Most similar to *Dorcoceras wallichii* in general facies and particularly in leaf shape but differs in the indumentum colour and lack of glands on the lower surface of the leaf. Also similar to *Dorcoceras geoffrayi* in the distribution of indumentum on the plant and inflorescence structure, but differing in the rusty brown indumentum on the abaxial leaf surface (pale in *D. geoffrayi*) and the generally longer, narrower leaves. Type: Thailand, Kanchanaburi, Sai Yok, Wat Phrom Moli Lok, 130 m, 14°12’12”N, 99°8’0”E, 7 Aug. 2012, fl., fr., *Middleton, Karaket, Suddee & Triboun 5283* (holotype **E**; isotypes **BK**, **BKF**, **E**, **SING**). Fig. 1.

Rosulate herb. *Leaves* sessile or shortly petiolate, with petiole up to 1 cm long; lamina 4–10 × 0.5–2 cm, 3–11 times as long as wide, narrowly elliptic to spathulate, apex acute, base attenuate, margin irregularly serrulate or finely serrate; adaxial surface mid-green with scattered multicellular, colourless to brown eglandular hairs; abaxial side paler, with an eglandular indumentum of a rusty-brown colour, especially abundant along the veins and by the apex; 2–4 pairs of secondary veins,

smooth or depressed on the adaxial surface, raised on the abaxial, tertiary venation seldom visible. *Inflorescence* a cyme, 3–12-flowered, with an indumentum of mixed eglandular and gland-tipped hairs; peduncles 9–15 cm long, brown; bracts 2–3 mm long, 0.3–0.5 mm wide, narrowly lanceolate, apex rounded, hirsute on the abaxial surface, glabrous on the adaxial; pedicels 0.3–3 cm long, white, predominantly with gland-tipped hairs and sporadic eglandular indumentum. *Calyx* with free, lanceolate sepals, 1.5–3 × 0.5–1 mm, apex finely obtuse, with sparse glandular and eglandular hairs on the outer side, glabrous on the inside. *Corolla* broadly campanulate, thickened at the base of the two upper lobes, pale purple, with the ventral surface white, externally glandular hairy especially laterally and ventrally, glabrous inside; tube 4–6 mm long; upper two lobes rounded, ca 4 × 3.5–4 mm, lateral lobes elliptic, 4–5 × 5–8 mm, ventral lobe elliptic, ca 6 × 9.5 mm. *Stamens* with filaments arising ca 1.5 mm above the corolla base, white, ca 1 mm long; anthers yellow, more or less rounded, ca 1 mm long and 2.5 mm across; staminodes 3, the laterals less than 0.5 mm long, the central ca 1 mm long. *Ovary* pale green, ca 3 mm long, with gland-tipped hairs; style white, ca 4 mm long, slightly bent downwards, glabrous; stigma capitate. *Capsule* strongly twisted, 1.5–2.5 cm long, with scattered glandular hairs. *Seeds* not seen.

Thailand.— SOUTH-WESTERN: Kanchanaburi [Mueang Kanchanaburi, 2 June 2000, *Triboun 1669* (**E**); Sadong Game Reserve, ca 100 m, 18 Nov. 1970, *Smitinand 11360* (**BKF**, **E**); Wongkanui, 16 June 1927, *Kerr 12948* (cult) (**BK**, **BM**); Sai Yok, Wat Phrom Moli Lok, 130 m, 7 Aug. 2012, *Middleton et al. 5283* (**BKF**, **E**)].

Distribution.— Endemic to Thailand (but not far from the Myanmar border).

Ecology.— On limestone, in mixed deciduous forest.


Figure 1. *Dorcoceras brunneum* C.Puglisi. A. Habit; B. Flower, front view; C. Flower, side view. Photos of *Middleton et al. 5883* by Preecha Karaket (A, C) and David Middleton (B).

Proposed IUCN conservation assessment.— Endangered ENB1ab(iii). The EOO is less than 4000 km$^2$, including the uncertain plants mentioned below, or only around 130 km$^2$ excluding these. In both cases this EOO would place the distribution into the range for Endangered. Several of the localities are not in protected areas and are subject to disturbance from human activities.

Note.— Two collections from Kanchanaburi and Prachuap Khiri Khan provinces are very similar to *Dorcoceras brunneum*, except that, crucially, they both lack the distinctive rusty brown indumentum on the abaxial side of the leaf. They cannot be assigned to *Dorcoceras wallichii* as they do not present the glands on the lower surface of the leaf which characterise the species. Both collections also differ from *Dorcoceras geoffrayi* in having a denser and longer leaf indumentum, in the lower leaf ratio and in the generally more oblanceolate shape of the leaf. They could be ecological variants of *Dorcoceras brunneum*, or perhaps a different species. One of these, the collection *Kerr 13506* (**BM**) from Kao Sai, is the only collection of *Dorcoceras* made in Prachuap Khiri Khan. The collection *Marcan 935* (**BM**) was collected in Kanchanaburi but no data are available to determine the exact locality.

**2. Dorcoceras geoffrayi** (Pellegr.) C.Puglisi, Taxon 65: 286. 2016.— *Boea geoffrayi* Pellegr., Bull. Soc. Bot. France 73: 425. 1926. Type: Cambodia, Kampot, Mont Pnom-Dong, *Geoffray 58* (lectotype **P!** [P00606312], designated by Burtt (1984: 420)). Figs. 2, 3.

Rosulate herb. *Leaves* petiolate, petiole inconspicuous or up to 4 cm long, with a white, long and eglandular indumentum; lamina 2.3–15 × 1.2–6 cm, 1.5–4 times as long as wide, lanceolate, elliptic to oblanceolate, apex acute to broadly acute, base acute to attenuate, margin entire to minutely serrulate; adaxial surface green with hispid, colourless eglandular hairs; abaxial side pale green, with the same indumentum, more abundant along the veins and the margin; 3–5 pairs of secondary veins, sunken in living plants but smooth and invisible in dried specimens on adaxial surface, slightly raised on the abaxial, tertiary venation seldom visible. *Inflorescence* a cyme, 1–8-flowered, with an indumentum of mixed eglandular and gland-tipped hairs; peduncles 5–12 cm long, with mixed glandular and eglandular hairs; bracts inconspicuous or 1–3 mm long, to ca 0.5 mm wide, ligulate, apex obtuse, tomentose; pedicels 0.3–1.5 cm long, brown, eglandular and glandular hairy, with glandular hairs reaching up to the receptacle; receptacle slightly slanted. *Calyx* with free, lanceolate to triangular sepals, 1–2 × 0.4–1 mm, apex thickened and narrowly obtuse, eglandular hairy (mixed hair types at the base) outside, glabrous inside. *Corolla* broadly campanulate, ventricose, thickened at the base of the two upper lobes, pale purple, paler in the throat, glandular hairy outside, glabrous inside; tube 4–6.5 mm long dorsally, 4–6 mm laterally, 4.8–8 mm ventrally; upper two lobes reflexed, elliptic, ca 3–5.5 × 4.5–6 mm, lateral lobes almost round to elliptic, ca 3–7 × 4.5–7.5 mm, ventral lobe round, 4–7 × 4.5–7 mm. *Appendages* between lips 0.6–1 mm long. *Stamens* with filaments arising 1–2.5 mm above the corolla base, pale yellow-green, slightly arching, 1–2.2 mm long, 0.4–0.6 mm diameter, with some glandular hairs at the anther's insertion or glabrescent; anthers yellow, triangular to rounded, ca 1.3–2.5 × 1.8–2.5 mm, coherent at the apex, thecae slightly divergent; staminodes 2, 0.2–0.5 mm long, arising 0.4–1.6 mm above corolla base. *Disk* absent or reduced to a 0.1 mm ring. *Ovary* pale green, 3.3–6 mm long, 1–1.2 mm diameter, with a dense indumentum of predominantly gland-tipped hairs, except at the very base which is glabrous; style pale green, 3–5 mm long, straight, with the same indumentum as the ovary at the base, otherwise glabrous; stigma shallowly lobed, with the lower lip bilobed (thus overall appearing trilobed). *Capsule* twisted, 1.5–3 cm long, pubescent. *Seeds* brown, elliptic, ca 0.2 × 0.3 mm.

Thailand.— NORTHERN: Sukhothai [Khiri Mat, Ram Kham Haeng National Park, Khao Luang, 990 m, 24 Oct. 2014, *Middleton et al. 5838* (**BKF**); 1181 m, 24 Oct. 2014, ibid., *Middleton et al. 5833* (**BKF**, **SING**); ibid., 1040 m, 24 Oct. 2014, *Middleton et al. 5835* (**BKF**, **SING**); ibid., 2 May 1922, *Kerr 5921* (**BM**); ibid., 10 Sept. 2010, *La-ongsri & Norsaengsri 1159* (**QBG**)]; NORTH-EASTERN: Phetchabun [Nam Nao, Nam Nao National Park, 400 m, 1 Aug. 2015, *Middleton et al. 5851* (**BKF**, **SING**)]; Loei [Na Haeo, ca 900 m, 29 July 1995, *Nanakorn et al. 4011* (**E**, **QBG**)]; Bueng Khan [Bueng Khla, Phu Wua Wildlife Sanctuary, 300 m, 30 July 2008, *Pooma et al. 7327* (**BKF**); ibid., 348 m, 15 June 2010, *Suddee et al. 4184* (**BKF**); ibid., 325m, 5 Aug. 2015, *Middleton et al. 5915* (**BKF**, **SING**)]; EASTERN: Si Sa Ket [Kantaraluk, Khao Phra Wihan National Park, Pha Mo I Daeng, 17 Sept. 2004, *Pooma et al. 4773*

(**BKF**, **E**); ibid., 560 m, 26 Aug. 2012, *Middleton et al. 5658* (**BKF**, **E**, **SING**); Kantaraluk, Dongrak Range, Chong Bat Lak, 600 m, 19 Aug. 1976, *Maxwell 76-575* (**AAU**, **BK**?, **L**)].

Distribution.— Cambodia.

Ecology.— On limestone or sandstone rocks on exposed summits or in mixed or dipterocarp deciduous forest with bamboo.

Proposed IUCN conservation assessment.— Least Concern (LC). This is the most widespread species of *Dorcoceras* in Thailand. Although it is not known from many localities, these are widely distributed and many are in protected areas.

Note.— The key characters of this species are that the leaves are often elliptic (not elongate), both leaf surfaces are densely tomentose with an indumentum of colourless eglandular hairs, and the leaf margin is serrulate to entire.

**3. Dorcoceras glabrum** C.Puglisi, **sp. nov.**

Most similar to *Dorcoceras brunneum* but differing in the structure of the inflorescence and in

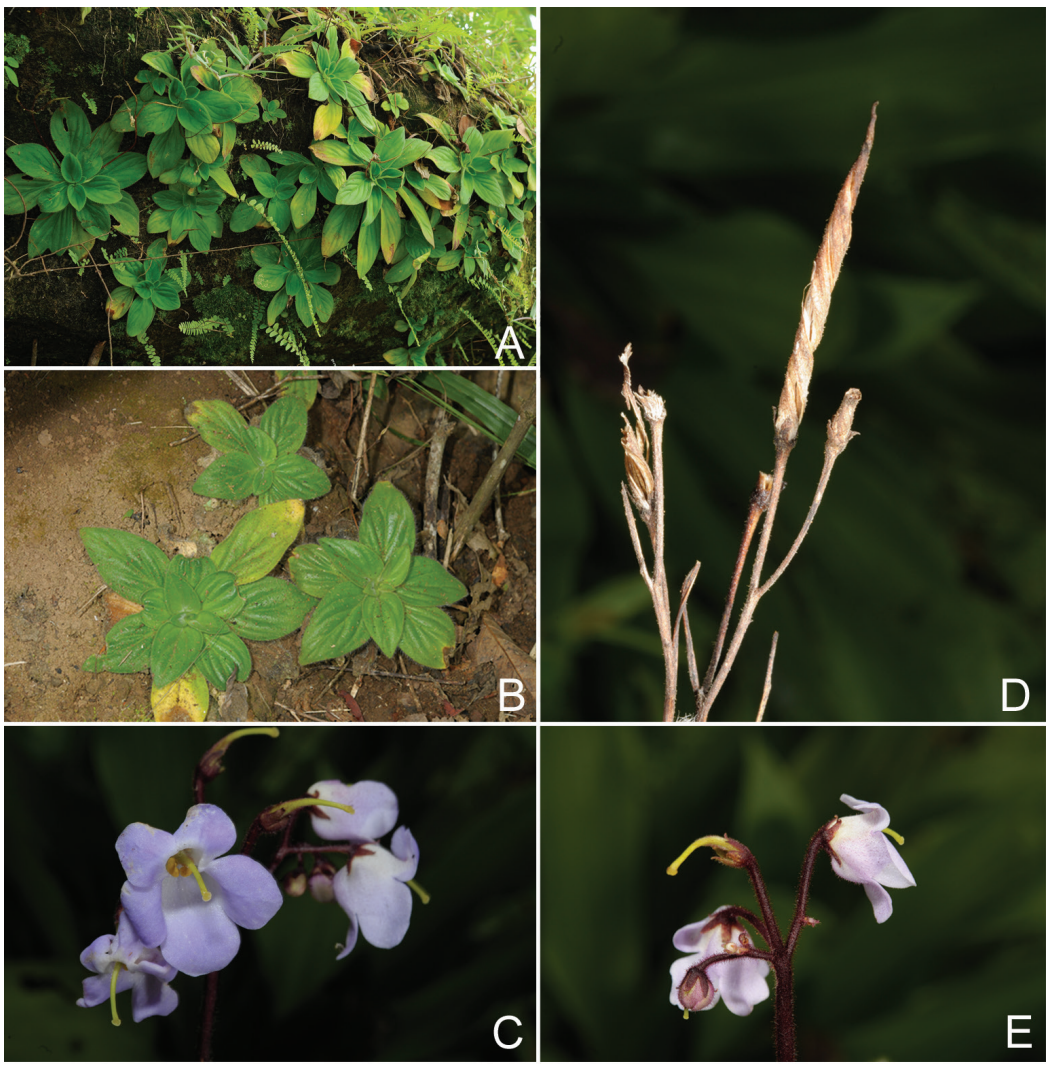


Figure 2. *Dorcoceras geoffrayi* (Pellegr.) C.Puglisi. A. Habit; B. Habit; C. Flower, front view; D. Fruit; E. Flower, side view. Photos of *Middleton et al. 5658* (A), *Middleton et al. 5835* (B) and *Middleton et al. 5833* (C–E). All photos by Preecha Karaket.

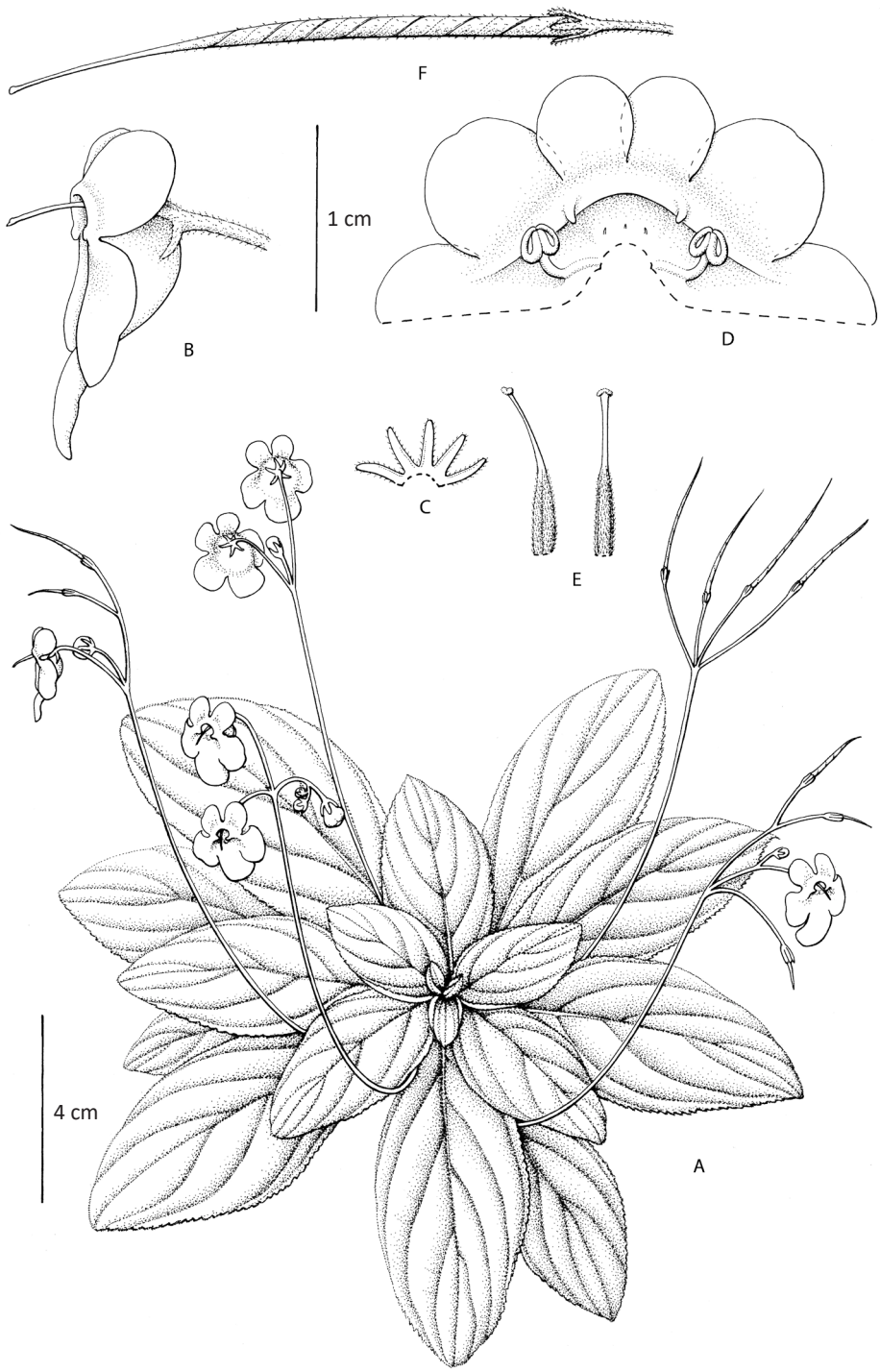


Figure 3. *Dorcoceras geoffrayi* (Pellegr.) C.Puglisi. A. Habit; B. Flower, side view; C. Calyx opened out; D. Corolla opened out; E. Pistil, dorsal and side views; F. Fruit.

having a glabrous adaxial leaf. Type: Thailand, Phetchaburi, Nongyapong District, Nongyapong forest, 10 Sept. 2002, fl. & fr., *Puudjaa 1117* (holotype **BKF**).

Rosulate herb. *Leaves* sessile or petiolate; lamina 3–8.6 × 1–2.5 cm, 2.5–5 times as long as wide, oblanceolate, apex acute to obtuse, base attenuate, margin more or less crenulate and undulate; adaxial surface glabrous, abaxial surface densely pubescent with an indumentum of eglandular multicellular hairs; 3–4 pairs of secondary veins, depressed on the adaxial surface and raised on the abaxial, tertiary venation inconspicuous. *Inflorescence* with an elongated axis with paired flowers along its length and, distally, cymes, 3–6-flowered, pubescent; peduncles 5–15 cm long; bracts 2–4 mm long, to 1 mm wide, apex acute, glabrous on the adaxial surface, pubescent on the abaxial; pedicels 0.4–2 cm long, delicate, with sparse eglandular hairs. *Calyx* slightly bilabiate with sepals almost completely free, narrowly lanceolate, 2–3 × ca 0.5 mm, apex acute, tomentose on the outer side, glabrous on the inside. *Corolla* purple, shortly campanulate, bilabiate and glabrous; tube ca 3 mm long; upper two lobes elliptic, ca 4.5 × 3.5 mm, lower central lobe rounded, ca 6 × 6.5 mm, lateral lobes ca 3.5 × 4 mm. *Stamens* with filaments attached ca 0.5 mm above the corolla base, ca 1 mm long; anthers ca 2 mm wide; staminodes 3, much reduced, less than 0.5 mm long. *Ovary* glabrous, ca 2 mm long; style ca 2.5 mm long, glabrous; stigma bilabiate. *Capsule* ca 1.5 cm long, twisted at least at dehiscence (only 1 dehisced fruit seen). *Seeds* elliptic, ca 0.3 × 0.1 mm.

Thailand.— SOUTH-WESTERN: Kanchanaburi [Ban Kao, Pattawee [Khao Patthawi], 90 m, 18 Nov. 1961, *Larsen 8311* (**BKF**)]; Phetchaburi [Nongyaplong, 10 Sept. 2002, *Puudjaa 1117* (**BKF**)].

Distribution.— Endemic to Thailand.

Ecology.— Dry evergreen forest.

Proposed IUCN conservation assessment.— Endangered ENB1ab(iii). Currently only known from two localities, both of which are subject to human disturbance.

Note.— The collection *Larsen 8311*, here included in *D. glabrum*, was listed by Xu *et al.* (2008) as *Paraboea ferruginea*. By removing this collection, the distribution of *Paraboea ferruginea* becomes restricted to the Langkawi Islands (Kedah, Malaysia).

**4. Dorcoceras wallichii** (R.Br.) C.Puglisi, Taxon 65: 286. 2016.— *Boea wallichii* R.Br., Cyrtandreae 124. 1839.— *Didymocarpus helicteroides* Wall., Numer. List n. 789. 1829, *nom. nud.* Type: Myanmar, Toong Dong [Thandaung], *Wallich list n.789* (lectotype **K-W** [K001111902], second step designated here; isolectotypes **G**, **E** *n.v.*, **BM** *n.v.*, **K** [K000249883]).

Rosulate herbs. *Leaves* sessile or petiolate; petiole to 1.5 cm long, often merging into blade, reduced or absent, covered in long eglandular hairs; lamina 1.4–6 × 0.6–2.2 cm, 1.8–6 times as long as wide, spathulate or oblanceolate to elliptic, apex broadly acute to obtuse, base acuminate or attenuate, margin crenate or serrate, sometimes indistinctly so, ciliate; adaxial surface green, eglandular pilose or sometimes glabrescent (hairs fall off easily), abaxial side green-brown, more densely hairy, especially along veins, and with minute sessile glands scattered throughout the lamina; 3–4 pairs of secondary veins, tertiary venation indistinct. *Inflorescence* a cyme with 1–10 flowers, with all axes having the same mixed indumentum of dimorphic eglandular hairs (long and short) and sparse short gland-tipped hairs; peduncles 4–10 cm long; bracts reduced and caducous, ca 0.5 × 0.1 mm, with long eglandular hairs; pedicels 0.1–4 cm long; receptacle slightly slanted with respect to the pedicel. *Calyx* tube 0.2 mm long, lobes lanceolate or narrowly so, 1–2.7 mm long, 0.4–1 mm wide, apex acute, eglandular hairy outside, with some gland tipped hairs at the base, glabrescent inside. *Corolla* shortly campanulate, pale purple, outside glandular hairy, becoming glabrescent after anthesis; tube ca 6.5 mm long ventrally, shorter dorsally; upper lobes not measured, lateral lobes ca 4 × 6.5 mm, ventral lobe 5–6.5 × 5.2–7 mm. *Stamens* arising ca 2.5 mm above corolla base, filaments ca 1.5 mm long, ca 0.2 mm diameter; anthers yellow, ca 1.7 × 1.4 mm, coherent, thecae parallel; staminodes not seen. *Pistil* not seen. *Capsule* strongly twisted, 1–1.8 cm long, eglandular hairy. *Seeds* light brown, broadly elliptic, mucronulate, 0.2–0.3 × ca 0.2 mm, surface reticulate.

Thailand.— NORTHERN: Chiang Mai [Chom Tong, Mae Soi Valley, 475 m, 1 Oct. 1991, *Maxwell 91-822* (**E**, **L**, **P**); Hot, Op Luang Gorge, 325 m, 24 Sept. 1989, *Maxwell 89-1133* (**L**, **MO**); Ban Na, Mae Ping, 8 Sept., 1911, *Kerr 2026* (**K**); Op Luang, Mae Ping Rapids, ca 500 m, 20 Oct. 1911, *Kerr 2178A* (**BM**, **K**); Ban Na Gorge, ca 450 m, 17 Oct. 1911, *Kerr 2178* (**ABD**, **BM**, **E**, **K**)]; Lampang

[Thoen, Mae Wa National Park, Mae Wa waterfalls, 350 m, 29 May 2011, *Pooma & Phattarahirantricin 7731* (**BKF**, **E**); ibid., 28 Aug. 2011, *Pooma & Phattarahirantricin 7760* (**BKF**)]; Tak [Larn Sang National Park, 350 m, 29 May 1973, *Geesink et al. 5518* (**BKF**); ibid., 350 m, 29 May 1973, *Geesink et al. 5516* (**AAU**, **BKF**, **C**, **L**); Sam Ngao, Bhumibol Dam, 23 Aug. 2010, *Norsaensgri 7151* (**QBG**)]; SOUTH-WESTERN: Kanchanaburi [Si Sawat, Erawan, 2 July 1974, *Larsen & Larsen 34018* (**AAU**)].

Distribution.— India (Mizoram), Myanmar.

Ecology.— Deciduous forest, in shaded areas on granite.

Proposed IUCN conservation assessment.— Least Concern (LC). This species is widespread and, in Thailand, found in several protected areas.

Notes.— The key characters of this species are the leaves spirally arranged and sessile; the lamina elliptic to oblanceolate or spathulate, more than twice as long as wide in mature leaves; eglandular hairs on adaxial surface, sessile glands (colourless in fresh plants, yellow-orange in herbarium specimens) and eglandular hairs on the abaxial; and margin entire to crenulate. Burtt (1984) designated a K specimen as the type in 1984 but did not distinguish between the two specimens (one in the general collection, one in K-W). A second step lectotypification is designated here.

## ACKNOWLEDGEMENTS

This work was supported by the BBSRC (UK) as part of a PhD studentship and the National Parks Board Singapore. We thank Chandee Hemrat, Preecha Karaket, Somran Suddee and Pramote Triboun for their work and companionship during field work, Preecha Karaket for the photos, Claire Banks for the illustration, and the curators and staff of the cited herbaria for providing access to the material.

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