

A revision of Pentaphragmataceae in Thailand with a new species and a new species record

MANOP POOPATH^{1,*}, SAWITA YOOPRASERT¹ & RACHUN POOMA¹

ABSTRACT

Pentaphragmataceae in Thailand is revised and a total of five species are recognised. A new species from Narathiwat, *Pentaphragma narathiwatense*, is described and illustrated. *Pentaphragma poilanei* is a new species record for Thailand. *Pentaphragma winitii* is synonymised under *Pentaphragma sinense*. A key to the Thai species, along with descriptions, distribution information, ecology and preliminary conservation assessments, are provided for all species.

KEYWORDS: Conservation, Flora of Thailand, Narathiwat, *Pentaphragma*, taxonomy.

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INTRODUCTION

Pentaphragmataceae J.Agardh. is a monogeneric family with a single genus, *Pentaphragma* Wall. ex G.Don, and comprises about 30 species distributed in South China, continental South-East Asia, Peninsular Thailand and throughout Malesia, with a concentration of species in Borneo (Airy Shaw, 1954; Lammers, 2007). The family is recognisable through a combination of characters: fleshy perennial herbs, alternate and asymmetrical leaves with serrulate or crenate margins, scorpioid inflorescences, 5-merous flowers, actinomorphic corolla, calyx adnate to ovary forming a hypanthium, and fruit a berry. In the field, the plants could be mistaken for some Begoniaceae due to sharing the features of being a fleshy herb, the asymmetrical leaves, and for sharing a similar forest floor habitat in evergreen forests. Phylogenetic studies show that Pentaphragmataceae, Sphenocleaceae, Stylidiaceae, Donatiaceae and Menyanthaceae are closely related in the Asterales-Campanulales-complex (Gustafsson & Bremer, 1995). More recently, the family has been included in the Asterales (APG, 2016). The genus has been revised for the following

Floras: three species in Flore Générale de l'Indo-Chine (Danguy, 1930), 20 species in Flora Malesiana (Airy Shaw, 1954) and two species in Flora of China (Hong & Turland, 2012). In addition, Kiew (1990) and Lin (2016) published three and two new species of *Pentaphragma* from Borneo, respectively.

In Thailand, two species were listed in Smitinand's Thai Plant Names (Pooma & Suddee, 2014): *Pentaphragma begoniifolium* (Roxb. ex Jack) Wall. ex G.Don and *P. horsfieldii* (Miq.) Airy Shaw. Plants of the World Online (POWO, 2021) accept *P. winitii* Craib as an endemic species in Thailand, but we here treat it as a synonym of *P. sinense* Hemsl. & E.H.Wilson. Although *P. poilanei* (Gagnep.) Gagnep. is treated as synonym of *P. sinense* in POWO (2021), the species is accepted here and is a new record for Thailand. Based on new materials from recent fieldwork and herbarium specimens from A, AAU, BK, K, P and QBG, a total of five species of *Pentaphragma* are recognised in this study, including a new species from Hala-Bala Wildlife Sanctuary, Narathiwat Province.

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TAXONOMY

KEY TO THE SPECIES

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|---|------------------------------------|
| 1. Stems short, not more than 10 cm long. Calyx conspicuously longer than corolla in open flowers | 5. <i>P. sinense</i> |
| 1. Stems elongate, usually more than 10 cm long. Calyx shorter than or equal in length to corolla in open flowers | |
| 2. Lamina base distinctly asymmetrical or strongly concave (begonia-like). Corolla lobes ovate-orbicular or obovate | 1. <i>P. begoniifolium</i> |
| 2. Lamina base symmetrical or slightly asymmetrical. Corolla lobes spatulate or oblong | |
| 3. Calyx shorter than corolla in open flowers. Corolla connate at base | 4. <i>P. poilanei</i> |
| 3. Calyx slightly shorter than or equal in length to corolla in open flowers. Corolla free to base | |
| 4. Inflorescences scorpioid, 2–9 cm long, flowers dense, up to 40. Stigma oblong or ovoid, not lobed | 2. <i>P. horsfieldii</i> |
| 4. Inflorescences spikes, 1.5–2 cm long, flowers rather lax, up to 10. Stigma discoid, 5 lobed | 3. <i>P. narathiwatense</i> |

1. *Pentaphragma begoniifolium* (Roxb. ex Jack) Wall. ex G. Don, Gen. Hist. 3: 731. 1834; de Candolle, Prodr. 7: 496. 1839; Miquel, Fl. Ned. Ind. 2: 568. 1857; Kurz, J. Asiat. Soc. Bengal 46(2): 210. 1877; Clarke in Hooker, Fl. Brit. India 3: 437. 1881; Ridley, Fl. Malay Penins. 2: 202. 1923; Kerr, Fl. Siam. 2: 308. 1936; Airy Shaw, Fl. Males., Ser. 1, Spermat. 4: 525. 1954.—*Phyteuma begoniifolium* Roxb. [Hort. Bengal 35. 1813, **nom. nud.**] ex Jack, Malayan Misc. 1: 5. 1820. Type: [Peninsular Malaysia], Penang, Wallich s.n. in Numer. List No. 1313 (neotype **K-W** [K000854700, digital image!], designated here; isoneotypes **K-W** [K000854701, K000854702, K000854703, digital images!]). Fig. 1.

Stem 7–40 cm long. *Leaves*: lamina falcate-ovate, distinctly asymmetrical (begonia-like), 14–24 × 8–14 cm; apex acute to acuminate; base strongly concave on narrower side and round to cordate on wider side; margin shallowly serrulate; adaxial surface glabrous; abaxial surface puberulous; secondary veins depressed adaxially, tomentose abaxially; petioles 1.5–4 cm long, sparsely to densely hairy. *Inflorescences* terminal or subterminal, 1 in each axil, scorpioid, pendulous, strongly recurved, 2.5–8 cm long, bearing 10–40 florets, compact biseriate; bracts white, ± leafy, elliptic to orbicular, 1–2 × 1–2 cm; bracteoles white, orbicular or broadly ovate, 0.5–2 cm wide; peduncle 1–1.5 cm long. *Flowers*: pedicels 1–2 mm long. *Calyx* white, shorter than corolla in open flowers; tube (with hypanthium) broadly ovoid, ca 5 × 4–5 mm, sparsely glandular hairy on both sides; lobes equal, broadly ovate or orbicular, 2.5–3.5 mm in diam., apex round and reflexed. *Corolla* white, occasionally tinged purplish at base, slightly fused at base; lobes equal, ovate-orbicular or obovate, 3–4 × 2.5–3 mm, obtuse or rounded at apex, sagittate or subcordate at base, claw 0.5–0.7 mm long; sparsely hairy outside, glabrous

inside. *Stamens* ca 2 mm long; filaments ca 1 mm long; anthers ovate-oblong, ca 1 mm long, shortly acute at apex. *Styles* short, stout, ca 0.5 mm long; stigmas capitate or globose, ca 1 mm in diam. *Fruits* ellipsoid, 5–8 × 4–6 mm.

Thailand.—SOUTH-WESTERN: Kanchanaburi [Dai Chong Thong Waterfall, 244 m alt., 26 Aug. 2010, Chamchumroon *et al.* 4848 (**BKF**)]; PENINSULAR: Chumphon [Thung Tako, 13 June 1928, Put 1647 (**BK**); Pha To, 23 Jan. 1969, Smitinand & Schaller 10639 (**BKF**); Ban Ratcha Krut, 150–200 m alt., 6 July 1992, Larsen *et al.* 43177 (**AAU**, **BKF**); Ranong [Khao Nam Khao, Kraburi, 17 Apr. 1967, Sutheesorn 2253 (**BK**); Khao Nam Thong, 26 Apr. 1967, Sutheesorn 2411 (**BK**); Kapur, 100 m alt., 20 Nov. 1973, Santisuk 641 (**BKF**); *ibid.*, 100–250 m alt., 15 July 1979, Niyomdham *et al.* 314 (**BKF**); Khlong Nakha Wildlife Sanctuary, 50–100 m alt., 24 Apr. 1974, Larsen & Larsen 33317 (**AAU**, **BKF**); *ibid.*, near sea level, 25 Apr. 1973, Geesink & Santisuk 4903 (**BKF**); *ibid.*, 50 m alt., 22 June 1974, Geesink *et al.* 7396 (**BKF**); Ban Kam Phuan, Kapur, 24 Apr. 1974, Tippan 90 (**BK**); Ton Phet Waterfall, 40 m alt., 8 June 2008, Wongprasert 087-1 (**BKF**); Phangnga [s.loc., 16 July 1999, Watthana *et al.* 412 (**QBG**); Bang Paw, 26 May 1960, s.coll. 126 (**BK**); Khao Phra Mi, 150 m alt., 7 Jan. 1966, Hansen & Smitinand 11822 (**AAU**, **BKF**); *ibid.*, 60 m alt., 9 July 1972, Larsen *et al.* 30796 (**AAU**, **BKF**); Kuraburi, 50 m alt., 14 Aug. 1977, Santisuk 1172 (**BKF**); Ton Chong Pha Waterfall, 70 m alt., 7 Apr. 2018, Poopath *et al.* 2153 (**BKF**); Surat Thani [Khao Luang, Don Sak, 400 m alt., 9 Aug. 1927, Kerr 13227 (**BK**); Khao Sok, 100–200 m alt., 9 June 1992, Larsen *et al.* 42759 (**AAU**); Nakhon Si Thammarat [Thung Song, 24 July 1929, Rabil 180 (**BK**); Krung Ching Waterfall, 450 m alt., 2 Mar. 1986, Maxwell 86-120

(BKF); *ibid.*, Sirimongkol *et al.* 330 (BKF); Karom Waterfall, Lan Saka, Sirimongkol *et al.* 314 (BKF); Phatthalung [Khao Den, 200 m alt., 19 Apr. 1928, Kerr 15315 (BK)]; Trang [Ban Chong, 100 m alt., 20 Mar. 1960, Smitinand & Abbe 6585 (BKF); Khao Chong, 150 m alt., 14 June 1974, Geesink *et al.* 7239 (BKF); *ibid.*, 100–150 m alt., 18 Nov. 1990, Larsen *et al.* 41554 (AAU)]; Satun [Tola, 50 m alt., 3 Jan. 1928, Kerr 13869 (BK); 10 Feb. 1929, Lakshnakara 329 (BK)]; Songkhla [Ton Nga Chang Wildlife Sanctuary, 300 m alt., 21 Aug. 1992, Niyomdham & Puudjaa 3113 (BKF)]; Yala [Betong, 300 m alt., 31 July 1923, Kerr 7894 (BK); Bannang Sata, 5 Dec. 1966, Sangkhachand 1391 (BKF); Bang Lang Reservoir, 200–250 m alt., 17 June 1992, Larsen *et al.* 42958 (AAU, BKF); Chulaphon Phatthana 7 area, 160 m alt., 20 May 2005, Middleton *et al.* 3499 (BKF)]; Narathiwat [Ba Chaw, Sukhirin, 600 m alt., 14 July 1923, Kerr 7195 (BK); Chatwarin Waterfall, 150–300 m alt., 15 Aug. 1995, Larsen *et al.* 45585 (AAU, BKF, QBG); To Mo gold mine, 200 m alt., 21 July 2004, Pooma *et al.* 4490 (BKF)]

Distribution.— Lower Myanmar, SW & Peninsular Thailand, northern Peninsular Malaysia.

Ecology.— Evergreen forest, moist and shady places by streams, up to 600 m alt. Flowering and fruiting March–December.

Vernacular.— Ai biao (อ้ายเปี้ยว)(Satun); wan hu mi (ว่านหุมี)(Chumphon, Nakhon Si Thammarat); phak pa (ผักป่า)(Yala).

Preliminary conservation assessment.— LC (Least Concern). Although it is not a widely distributed species, it is known from several localities within

its range, including several well-protected areas. It has a relatively large Extent of Occurrence (EOO) of approximately 195,300 km² and an Area of Occurrence (AOO) of 108 km².

Note.— The first publication of the name *Phyteuma begoniifolium* did not include a description or specimen list, only stating that the species is found in P. of W. I. = Prince of Wales Island [Penang Island] (Roxb., 1813). It was later validated by Jack (1820) who noted it was found on ‘Pulo Pinang’ [Penang Island]. Later, the species was transferred to *Pentaphragma* as *P. begoniifolium* by Wallich (1829) who included it in his *Cat. No. 1313* with a collection from Penang in 1822. This combination, however, was invalid as the genus had not yet been validly described, only later being validated by Don (1834) who referred to Wallich’s collection. As no original material has been found, we thus select a neotype from amongst the material under *Numer. List No. 1313* for which we have identified 13 sheets of herbarium specimens deposited in **G** [G00322420], **GZU** [GZU000020599], **K-W** [K001112700–K001112704], **K** [K000854742, K000854743], **L** [L 0001681, L 0001682] and **P** [P00650055, P00650056]. Within these ranges, only K001112700, K001112701, K001112702 and K001112703 in **K-W** have the original label or handwriting of ‘*Phyteuma begoniifolia* [or -um] Roxb. Penang 1822’ on them. The specimen K001112700 is designated here as the neotype because it exhibits both vegetative and reproductive characters. The sheet in **G** is a specimen of *Scaevola* L. though the slip of *Numer. List No. 1313* might be a mistake.



Figure 1. *Pentaphragma begoniifolium* (Roxb. ex Jack) Wall. ex G.Don. Photographed by R. Pooma.

2. *Pentaphragma horsfieldii* (Miq.) Airy Shaw, Kew Bull. 8(2): 249. 1953; Airy Shaw, Fl. Males., Ser. 1, Spermat. 4: 527. 1954.—*Cyrtandra horsfieldii* Miq. Fl. Ned. Ind. 2: 738. 1858. Type: [Indonesia], Banca [Bangka], *Horsfield 36* (lectotype **K** [K000854725, digital image!], designated here).

—*Pentaphragma scortechinii* King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(1): 55. 1906. Type: [Peninsular Malaysia], Perak, Larut, Jan. 1882, *King's collector 2653* (lectotype **K** [K000854741, digital images!], first-step designated by Kiew [1989: 9], second-step designated here; isolectotype **K** [K000854740, digital images!]).

—*Pentaphragma sumatrana* Ridl., J. Fed. Malay States. Mus. 8(4): 56. 1917. Type: [Indonesia], Sumatra, Barong Baru, Tapan, 6 June 1914, *Robinson & Kloss 89* (holotype **BM** [BM014140219, image!]).

—*Pentaphragma integrifolium* Merr., Pap. Michigan Acad. Sci. 19: 202. 1934. Type: [Indonesia], Sumatra (East Coast), Bandar Poelau, Asahan, *Yates 2597* (holotype **NY** [00278847, digital image!]; isotype **K** [K000854724, digital image!]).

—*Pentaphragma integrifolium* var. *longipetiolata* Merr. Pap. Michigan Acad. Sci. 19: 203. 1934. Type: [Indonesia], Sumatra (East Coast), Silo Maradja, Asahan, in the vicinity of Taloen Djoring, Dec. 1927, *Si Toroes 61* (holotype **NY** [00278845, digital image!]; isotypes **GH** [00521067, digital image!], **MICH** [1192630, digital image!]).

Stem 3–30 cm long. *Leaves*: lamina ovate or elliptic, slightly asymmetrical, 12–25 × 6–13 cm; apex acute to obtuse; base obtuse or slightly attenuate and slightly asymmetrical; margin shallowly serrulate or entire and frequently revolute; adaxial surface glabrous; abaxial surface glabrescent or puberulous; secondary veins depressed adaxially, tomentose abaxially; petioles 2–8.5 cm long, sparsely to densely hairy. *Inflorescences* terminal or subterminal, 1 in each axil, scorpioid, pendulous and strongly recurved, 2–9 cm long, bearing 6–40 florets, compact biseriate; bracteoles light green or white, obovate or oblanceolate, 0.5–1 cm long; peduncle 0.7–2 cm long. *Flowers*: pedicels sessile. *Calyx* white, equal in length to corolla in open flowers; tube (with hypanthium) ovoid, 6–8 × 3–4 mm, sparsely to densely hairy on both sides; lobes unequal, broadly ovate, suborbicular, oblong, 2–3 × 1–2.5 mm, apex round and reflexed. *Corolla* white or greenish white, free to base, spatulate, ca

2–3 × 2 mm, apex round, base attenuate, densely hairy outside, glabrous inside. *Stamens* ca 2 mm long; filaments 0.5–1 mm long; anthers lanceolate, 1–1.3 mm long, apex acuminate. *Styles* short and stout, ca 0.5 mm long; stigmas oblong or ovoid, 1.3–2 mm long, not lobed. *Fruits* obovoid, ca 5 × 3 mm.

Thailand.—PENINSULAR: Narathiwat [Sukhirin, Ban Toh Moh, 450 m alt., 22 Apr. 1931, *Lakshnakara 755* (**BK**); Waeng, 300–500 m alt., 4 Mar. 1974, *Larsen & Larsen 32911* (**BKF**); *ibid.*, 200 m alt., 13 June 1970, *Smitinand 10936* (**BKF**); *ibid.*, 16 Aug. 1998, *Puudjaa 482* (**BKF**); *ibid.*, 550 m alt., 15 Sept. 2003, *Puudjaa 1246* (**BKF**); *ibid.*, 350 m alt., 24 Aug. 2006, *Poopath et al. 98* (**A, BKF**); *ibid.*, 96 m alt., 11 May 2019, *Poopath et al. 2433* (**BKF**); Khao Ai Kapoh, 150–200 m alt., 14 Apr. 1996, *Niyomdham & Puudjaa 4731* (**BKF**).

Distribution.—Peninsular Thailand, Peninsular Malaysia, Sumatra, Borneo (Sarawak).

Ecology.—Evergreen forest, moist and shady places by streams, up to 1,300 m alt. Flowering and fruiting April–December.

Vernacular.—Ai biao noi (อ้ายเปี้ยวน้อย) (Proposed here).

Preliminary conservation assessment.—Least Concern (LC). It has a wide distribution with a large Extent of Occurrence (EOO) of approximately 763,300 km², but has a small Area of Occurrence (AOO) of about 60 km² and fewer than 20 known localities. Although its habitat is threatened by logging and farming activities in Sumatra and Sarawak (Gaveau *et al.*, 2014), given the large extent of occurrence and well-protected localities in Thailand, it is assessed here as Least Concern.

Notes.—Airy Shaw (1953) and later Kiew (1989) proposed a *Horsfield* specimen collected from Sumatra and housed in **BM** as the type of *Pentaphragma horsfieldii* but this specimen may not be original material. The protologue of the basionym, *Cyrtandra horsfieldii* Miq., stated that the plant was collected from Eiland Bangka [Bangka Island]. We have located only one specimen that specifically matches the protologue, *Horsfield 36* collected from Bangka Island and housed at **K** [K000854725]. The specimen has the original label with Miquel's handwriting on it and a determination slip by Horsfield as *Cyrtandra horsfieldii*. Therefore, it is selected here as the lectotype.

The original publication of *Pentaphragma scortechinii* King & Gamble included six collections (King & Gamble, 1906), from which Kiew (1989) selected King's collector 2653 at **K** as the type of the species. However, there are two sheets of this collection at **K**, K000854740 and K000854741. In this study, we designate the specimen with the barcode K000854741 as the lectotype of the species in a second step because the sheet has a handwritten description on it.

Pentaphragma sumatrana was published by Ridley (1917) based on a Robinson and Kloss collection from Mount Korinchi [Kerinci], Sumatra, with the location specified as Barong Bharu, Westside Barisan Range at 4,000 feet. A specimen has been located at **BM**, Robinson & Kloss 89 [BM014140219], which has the location "Barong Baru, Tapan", very similar to that in the protologue, and also has the original annotation of the species (Fig. 2). This specimen is cited here as the holotype because Ridley (1917: 56) stated in the protologue that there was only one specimen of this collection.

Specimens of the type collection of *Pentaphragma integrifolium* Merr., Yates 2597, were found in three herbaria: **K**, **NY** and **MICH**. However, the specimen at **MICH** [1192629] was collected in a different location, Masihi, from that stated in the original publication, Bandar Poeloe (Merrill, 1934). Therefore, it is excluded from the types here.

In the protologue of *Pentaphragma scortechinii* var. *parvifolium* King & Gamble, it was stated that this variety differed from *P. scortechinii* var. *scortechinii* in being a smaller plant, less villous and with smaller leaves and flowers. Airy Shaw (1954) included the name as a synonym of *P. horsfieldii* without an extensive explanation. Later, Kiew (1989) noted that *P. scortechinii* var. *parvifolium* could be reduced to *P. scortechinii* var. *scortechinii* because the height of mature *Pentaphragma* plants can be highly variable within a species. Kiew (1989) also stated that *P. scortechinii* var. *parvifolium* was not recognised by Ridley (1923). However, we found that Ridley (1923: 203) does indeed recognise the variety with his short description as "a small form". Since we have not seen specimens or online images of the syntypes of the name (Peninsular Malaysia, Pahang, at Salian River, Ridley; and Singapore, at Bukit Timah, Ridley) and the name has not otherwise been recorded for Thailand, we have not reached a conclusion on the status of this taxon.

3. *Pentaphragma narathiwatense* Poopath & Pooma, *sp. nov.*

Similar to *Pentaphragma horsfieldii* in its leaf shape and size, the indumentum on the leaf surface and petiole, and in its calyx and corolla shape, but differs in having a lax inflorescence which is a spike and 1.5–2 cm long with up to 10 flowers (vs dense, scorpioid, 2–9 cm long with up to 40 flowers), discoid and 5-lobed stigma (vs oblong or ovoid and not lobed). It is also similar to *P. ellipticum* Poulsen in its discoid and 3–5-lobed stigma, and in its leaf shape and size, except for the slightly asymmetrical base (vs symmetrical). It also differs from *P. ellipticum* in having a puberulous abaxial leaf surface, becoming tomentose on the secondary veins and petioles (vs glabrous), and the inflorescence being a spike or scarcely scorpioid, 1.5–2 cm long (vs scorpioid, 2.5–3.7 cm long). Type: Thailand, Hala-Bala Wildlife Sanctuary, Waeng, Narathiwat, ca 150 m alt., 14 June 2005, fl., Niyomdham & Puudjaa 7482 (holotype **BKF!**). Fig. 3.

Herb to 18 cm tall, young parts puberulous to tomentose. *Leaves*: lamina ovate or elliptic, indistinctly asymmetrical, 11–16 × 7–8.5 cm; apex acute; base cuneate or obtuse and slightly asymmetrical; margin shallowly serrulate and frequently revolute; adaxial surface glabrous; abaxial surface puberulous; secondary veins depressed adaxially, tomentose abaxially; petioles 3–4 cm long, densely hairy. *Inflorescences* terminal or subterminal, 1–2 in each axil, a spike, erect or pendulous and slightly recurved to straight, 1.5–2 cm long, bearing 4–10 flowers; bracteoles light green or white, oblanceolate or linear-spathulate, 0.5–0.8 cm long; peduncle 0.7–1 cm long. *Flowers*: pedicels sessile. *Calyx* white, equal in length to corolla in open flowers; tube (with hypanthium) narrowly ovoid, 5–6 × 2.5–3 mm, sparsely to densely hairy outside, glabrous inside; lobes unequal, oblong or suborbicular, 2–3 × 1–2 mm, apex round and not reflexed. *Corolla* white, free to base, spatulate, 2–3 × 1.5–2 mm, apex round, base attenuate, densely hairy outside, glabrous inside. *Stamens* 5, ca 2 mm long; filaments 0.8–1 mm long; anthers linear, 1–1.3 × 0.2 mm, apex acuminate. *Styles* short and stout, 0.5–0.8 mm long; stigmas discoid with 5 lobes, 0.8 mm diam. *Fruits* not seen.

Thailand.—PENINSULAR: Narathiwat [Hala-Bala Wildlife Sanctuary, Waeng, Niyomdham & Puudjaa 7482 (**BKF!**)].



Figure 2. Holotype of *Pentaphragma sumatrana* Ridl. at BM (BM014140219). Photographed by I.M. Turner.



Figure 3. *Pentaphragma narathiwatense* Poopath & Pooma: A. habit; B. flower; C & D. calyx lobes; E. petal; F. stamen; G. style (All from Niyomdham & Puudja 7482). Drawn by O. Kerdkaeo.

Distribution.— Known only from the type locality.

Ecology.— Evergreen forest, moist and shady places by streams, ca 150 m alt. Flowering in June.

Vernacular.— Khana pa bala (ค่าน้ำป่าบาลา) (Proposed here).

Etymology.— The specific epithet of the new species refers to the province from which the type was collected.

Preliminary conservation assessment.— Data Deficient (DD). This species is only known from one locality in lowland evergreen forest near a village which is a tourist area. Its population size is unknown. For further assessment, the number of individuals and populations and more details on possible threats are required.

Note.— *Pentaphragma narathiwatense* and *P. horsfieldii* are similar in leaf characteristics and they can hardly be distinguished when sterile but are distinct when flowering. Both species also occur in the same area and habitat in Hala-Bala Wildlife Sanctuary. *Pentaphragma horsfieldii* is common and widespread from Peninsular Thailand, Peninsular Malaysia, Sumatra to Borneo but the new species is very rare and the distribution appears to be very restricted. *Pentaphragma ellipticum* only occurs in lower Peninsular Malaysia, Singapore and the Riau Archipelago and there are no records of it from Thailand.

4. *Pentaphragma poilanei* (Gagnep.) Gagnep., Rev. Bot. Appl. Agric. Colon. 8: 621. 1928; Danguy, Fl. Indo-Chine 3: 698. 1930.— *Francfleurya poilanei* Gagnep., Rev. Bot. Appl. Agric. Colon. 7: 664. 1927. Type: [Vietnam], Annam, Quang Tri, massif de Dong Ché, E. *Poilane 11308* (lectotype **P** [P00650065, digital image!], designated here). Figs. 4 & 5.

— *Pentaphragma sinense* Hemsl. & E.H. Wilson. in Thuan, Fl. Cambodge, Laos & Vietnam 9: 42. 1969, *pro parte*.

Stem short or elongate, to 30 cm long. *Leaves*: lamina ovate or elliptic, indistinctly asymmetrical, 12–20 × 9–13 cm; apex acute; base obtuse or round and slightly asymmetrical; margin entire and shallowly serrulate near apex; adaxial surface glabrous; abaxial surface puberulous; secondary veins slightly depressed adaxially, tomentose abaxially; petioles

3.5–10.5 cm long, densely hairy. *Inflorescences* terminal or subterminal, 1–2 in each axil, scorpioid, erect or pendulous and strongly recurved to slightly recurved, 4–5 cm long, bearing 4–24 flowers; bracteoles light green or white, oblanceolate or lanceolate, 6–10 × 1.5–2.5 mm; peduncle 2–4 cm long. *Flowers*: pedicels 1.5–3.5 mm long. *Calyx* white, shorter than corolla in open flowers; tube (with hypanthium) ovoid, 5–6 × 3–4 mm, glabrescent or pubescent outside; lobes equal, obovate or oblanceolate, 3–4 × 2.5–3 mm, apex obtuse and slightly recurved, margin pubescent. *Corolla* white, 5–7 mm long, connate at base; lobes oblong or lanceolate, 4–5 × ca 2 mm, apex acute or obtuse and recurved, sparsely hairy outside, glabrous inside, slightly thickened when fresh. *Stamens* 2.5–3 mm long; filaments 1.5–1.7 mm long; anthers oblong, 1–1.3 mm long, apex acute. *Styles* 2 mm long; stigmas ovoid or oblong, 1–2 mm long. *Fruits* ovoid, ca 1 × 0.5 cm, glabrous.

Thailand.— SOUTH-EASTERN: Trat [Khlong Kaeo National Park, 97 m alt., 28 July 2020, *Poopath & Karaket 2542* (**BKF**); *ibid.*, 330 m alt., 29 July 2020, *Poopath & Karaket 2552* (**BKF**)].

Distribution.— SE Thailand, Vietnam (Quang Binh, Quang Tri, Thua Thien Hae, Da Nang). It should also be expected in Cambodia.

Ecology.— Evergreen forest, moist and shady places by streams, 50–1,000 m alt. Flowering and fruiting April–October.

Vernacular.— Khana pa (ค่าน้ำป่า) (Proposed here).

Uses.— Young leaves are used for cooking, taste similar to Chinese Kale.

Preliminary conservation assessment.— Endangered (EN B2ab(iii)). It is currently known from not more than five localities over its distribution range with an Extent of Occurrence (EOO) of approximately 66,200 km² and an Area of Occurrence (AOO) of about 28 km². The locality in Thailand is isolated from the main populations in central Vietnam. The Thai population is in a protected area but near to a waterfall impacted by tourism.

Notes.— After careful study of the specimens, we maintain *Pentaphragma poilanei* as a species distinct from *P. sinense*, under which it is often synonymised, due to differences in stem length and

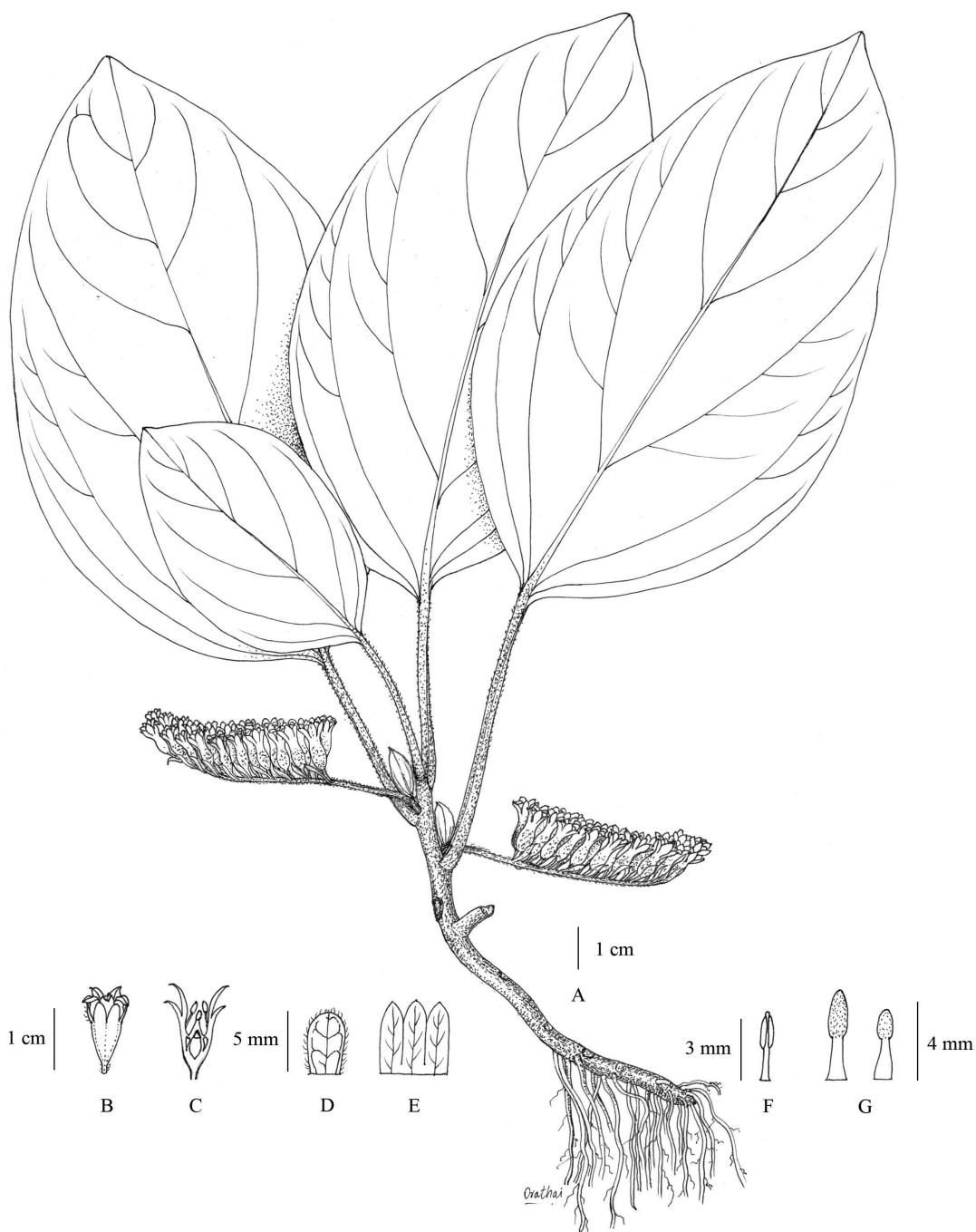


Figure 4. *Pentaphragma poilanei* (Gagnep.) Gagnep.: A. habit; B. flower; C. longitudinal section of flower; D. calyx lobes; E. corolla; F. stamen; G. style (All from Poopath & Karaket 2542 and 2552). Drawn by O. Kerdkaeo.



Figure 5. *Pentaphragma poilanei* (Gagnep.) Gagnep. Photographed by P. Karaket.

the relative ratio of calyx to corolla length in open flowers (see key above), as well as its geographical distribution. The species is recorded for the first time from Thailand. There are five syntypes of *P. poilanei* at **P**: *Poilane 10947* [P00650063, P00650064], *Poilane 11307* [P00650066, P00650067] and *Poilane 11308* [P00650065]. The specimen P00650065 is chosen as the lectotype because it has a label with illustrations of floral characteristics attached to the specimen. Although we could not find the syntype *Poilane 10325*, we did find the specimen *Poilane 10525* [P03025323], which is a specimen of *P. poilanei* and was collected from the same location as the other syntypes, massif de Dong Ché, prov. Quang Tri. It is possible that *10325* was a misprint for *10525*.

In a revised account of *Pentaphragma sinense* in Cambodia, Laos and Vietnam by Thuan (1969), 11 collections housed in **L** and **P** were examined. These collections can be identified as:

Pentaphragma poilanei (Eberhardt 2836 [P03025310, P03025311]; *Poilane 7004* [P03025321]; *Poilane 10525* [P03025323]; *Poilane 10947* [P00650063, P00650064]; *Poilane 11307* [P00650066, P00650067]; *Poilane 11308* [P00650065]).

Pentaphragma sinense (Pételot 3880 [P03025319, P03025320]; *Poilane 31649* [P03025316, P03025317]; *Poilane 31821* [L.3002890, P03025314, P03025315]; *Poilane 31886* [P03025318]).

A dubious collection (Eberhardt 2003 [P03025312, P03025313]) that might belong to either *Pentaphragma poilanei* or *P. honbaense* (A.Chev. & Gagnep.) Gagnep.

5. *Pentaphragma sinense* Hemsl. & E.H.Wilson, Bull. Misc. Inform. Kew 1906(5): 160. 1906; Thuan, Fl. Cambodge, Laos & Vietnam 9: 42. 1969, *pro parte*; D.Y.Hong & Turland, Fl. China 19: 564. 2012. Type: [Vietnam], Chino-Tonking frontier, Lao Cai, Aug. 1899, *Wilson 2787* (holotype **K** [K000854737, digital image!]).

— *Pentaphragma winitii* Craib, Bull. Misc. Inform. Kew 1935(5): 334. 1935, **syn. nov.** Type: Thailand, Nan, Mae Sanian, 390 m, 5 Aug. 1926, *Winit 1786* (lectotype **K** [K000854736, digital image!], designated here; isoelectotypes **BKF** [SN046549, SN214370]).

Stem short and stout, not more than 10 cm long; internodes obscure, less than 5 mm long. *Leaves*: lamina ovate or elliptic, indistinctly asymmetrical, 12–20 by 6–10 cm; apex acute; base obtuse, cuneate or subattenuate and slightly asymmetrical; margin entire or shallowly serrulate; adaxial surface glabrous; abaxial surface puberulous; secondary veins slightly depressed adaxially, tomentose abaxially; petioles 3.5–10.5 cm long, densely hairy. *Inflorescences* terminal or subterminal, 1–2 in each axil, scorpioid, erect or pendulous and strongly recurved, 3.5–6 cm long, bearing 4–18 flowers; bracteoles light green or white, oblanceolate or lanceolate, 5–10 × 1–1.3 mm; peduncle 1–4 cm long. *Flowers*: pedicel 1–2 mm long. *Calyx* white, longer than corolla in open flowers; tube (with hypanthium) narrowly ovoid, 4–5 × ca 2 mm, glabrous or glabrescent on both sides; lobes equal, oblanceolate, 3.5–5 × 1.7–2.3 mm, apex acute. *Corolla* white, free to base, oblong, 3–4 × ca 1.5 mm; apex apiculate and recurved, glabrous on both sides. *Stamens* 2.5–3 mm long; filaments 1.3–2 mm long; anthers oblong,

0.7–1 mm long, apex acute. *Styles* ca 1 mm long; stigmas ovoid or conic, ca 0.5 mm long. *Fruits* narrowly ellipsoid, 7–9 × 2.5–3 mm.

Thailand.— NORTHERN: Nan [Muang, Mae Sanian, 390 m alt., 5 Aug. 1926, *Winit 1786* (**K**, **BKF**); Doi Pha Chang Wildlife Sanctuary, 450 m alt., 4 Aug. 1998, *Maxwell 98-800* (**BKF**)].

Distribution.— Northern Thailand, S China (southern Yunnan), N Vietnam (Lao Cai). From its known distribution, it is to also be expected in Laos.

Ecology.— Evergreen forest or deciduous forest with bamboo, moist and shady places by streams, 400–1,500 m alt. Flowering and fruiting in August.

Vernacular.— Khana pa chin (กะน้ำป่าจีน) (Proposed here).

Preliminary conservation assessment.— Endangered (EN Ba2b(ii,iii)). It is known from few locations across its distribution range with an Extent of Occurrence (EOO) of approximately 74,800 km², and an Area of Occurrence (AOO) of about 24 km². The distribution is severely fragmented with a few adjacent localities in S China, one in N Vietnam, and one in N Thailand. Its habitat is threatened by farming activities in Thailand.

Notes.— *Pentaphragma winitii* was described by Craib (1935) based upon specimens of *Winit 1786* collecting from Me Sanian, Nan Province. The species has similar dominant characters to *P. sinense*, including a short and stout stem and a glabrous calyx that is conspicuously longer than the corolla in open flowers. The other characters of *P. winitii* also fall within the overall variation of *P. sinense*. The species is thus synonymised under *P. sinense* in this study. For the typification of *P. winitii*, there are three sheets of *Winit 1786* at **BKF** [SN046549, SN214370] and **K** [K000854736]. The specimen at **K** is designated here as the lectotype because it has the original handwritten determination of the species on it, and it is also the best preserved sheet.

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