



## *Primulina alba*, a new cave-dwelling species of Gesneriaceae from a Limestone Area in Tiandeng County, Guangxi, China

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**ABSTRACT:** *Primulina alba* R.F.Li & B.Pan, a new species of Gesneriaceae from the limestone area of Guangxi, Southwest China, is described and illustrated. This new species is morphologically similar to *P. cerina* F.Wen, Yi Huang & Chou. It can be easily distinguished from the latter by several characteristics, such as the size of leaf blades, the indumentum, size of the corolla, the position of stamens, etc. The conservation status of *P. alba* can be considered Vulnerable [VU D1] according to the *Guidelines for Using the IUCN Red List Categories and Criteria* (IUCN, 2022).

**KEY WORDS:** Flora of Guangxi, Limestone, *Primulina cerina*, *Primulina cordifolia*, *Primulina jiangyongensis*, *Primulina mollifolia*.

### INTRODUCTION

Almost all species of *Primulina* Hance (Hance, 1883) in the family Gesneriaceae are lithophytic herbs, mainly distributed in the limestone regions of South and Southwest China and North Vietnam (Wang and Pan, 1990; Wang *et al.*, 1998; Wei *et al.*, 2010; Wei, 2018). For almost 130 years, this monotypic genus included only one species (*P. tabacum* Hance). *Primulina* was later revised and expanded based on molecular and morphological evidence (Wang *et al.*, 2011; Weber *et al.*, 2011). The redefinition expanded the genus to about 140 species (include infraspecific taxon) and newly described species since increased it to around 140 species (include infraspecific taxon) (Weber *et al.*, 2011; Xu *et al.*, 2012) within the formerly monotypic genus. All species of *Chiritopsis* W.T.Wang, two species of *Wentsaiboaea* D.Fang & D.H.Qin, and almost all species of Sect. *Gibbosaccus* Clarke of *Chirita* Buch.-Ham. Ex Don were transferred into *Primulina* (Weber *et al.*, 2011; Möller *et al.*, 2013, 2016; Wen *et al.*, 2022).

Over the last decade, due to expanded exploration opportunities and field observations, 99 new taxa of *Primulina* were formally published. Therefore, *Primulina* has grown to about 227 accepted species (excluding infraspecific taxon) (POWO, 2022; GRC, 2022). 210 species and 16 varieties are distributed and endemic to China (GRC, 2022).

During botanical surveys in karst regions of Southwest Guangxi, South China, in the spring of 2020, an unknown species of *Primulina* was collected by Bo Pan. It was introduced to the nurseries of the National Gesneriaceae Germplasm Resource Bank of Guangxi Institute of Botany (NGGRB), the Gesneriad Committee of China Wild Plant Conservation Association (GC), and The Gesneriad Conservation Center of China (GCCC).

After critically comparing this material with specimens from herbaria and checking references and monographs, we confirmed that it represents a new species of *Primulina* and describe it here.

### MATERIALS AND METHODS

Field surveys were carried out in the karst region of Tiandeng County of Southwest Guangxi in China in May 2020. The descriptions and illustrations presented here are based on an analysis of the habits and characteristics of wild populations in field surveys and the type specimens stored in IBK. Comparisons of diagnostic characteristics were based on living plants from China and Vietnam. Observing the living plants introduced and cultivated in the nurseries of the NGGRB and the GCCC, we can diagnose whether their characteristics will change due to changes in the growing environment. After examination of the specimens stored in related Herbaria (HITBC, IBK, KUN, PE) and digital specimens online, especially type specimens from E, HN, K, P, VMN, such as: Chinese Virtual Herbarium (<http://www.cvh.ac.cn/>) in China and Global Plants on JSTOR (<https://plants.jstor.org/>) and consulting the related taxonomic publications of *Primulina* from the adjacent regions (Wang, 1981, 1982, 1986; Wang *et al.*, 1990, 1998; Phuong, 2005; Wei *et al.*, 2010; Ning *et al.*, 2013; Li *et al.*, 2014; Cai *et al.*, 2015; Wei, 2018, 2022; Xin *et al.*, 2018, 2021; Li *et al.*, 2019; Wen *et al.*, 2019, 2022). The terminology follows Wang *et al.* (1998). The specific epithets and the authors' names align with the International Plant Names Index, making sure there are no repetitions. (IPNI continuously updated). The preliminary conservation assessments followed the *Guidelines for Using the IUCN Red List Categories and Criteria* Version 15 (IUCN, 2022).

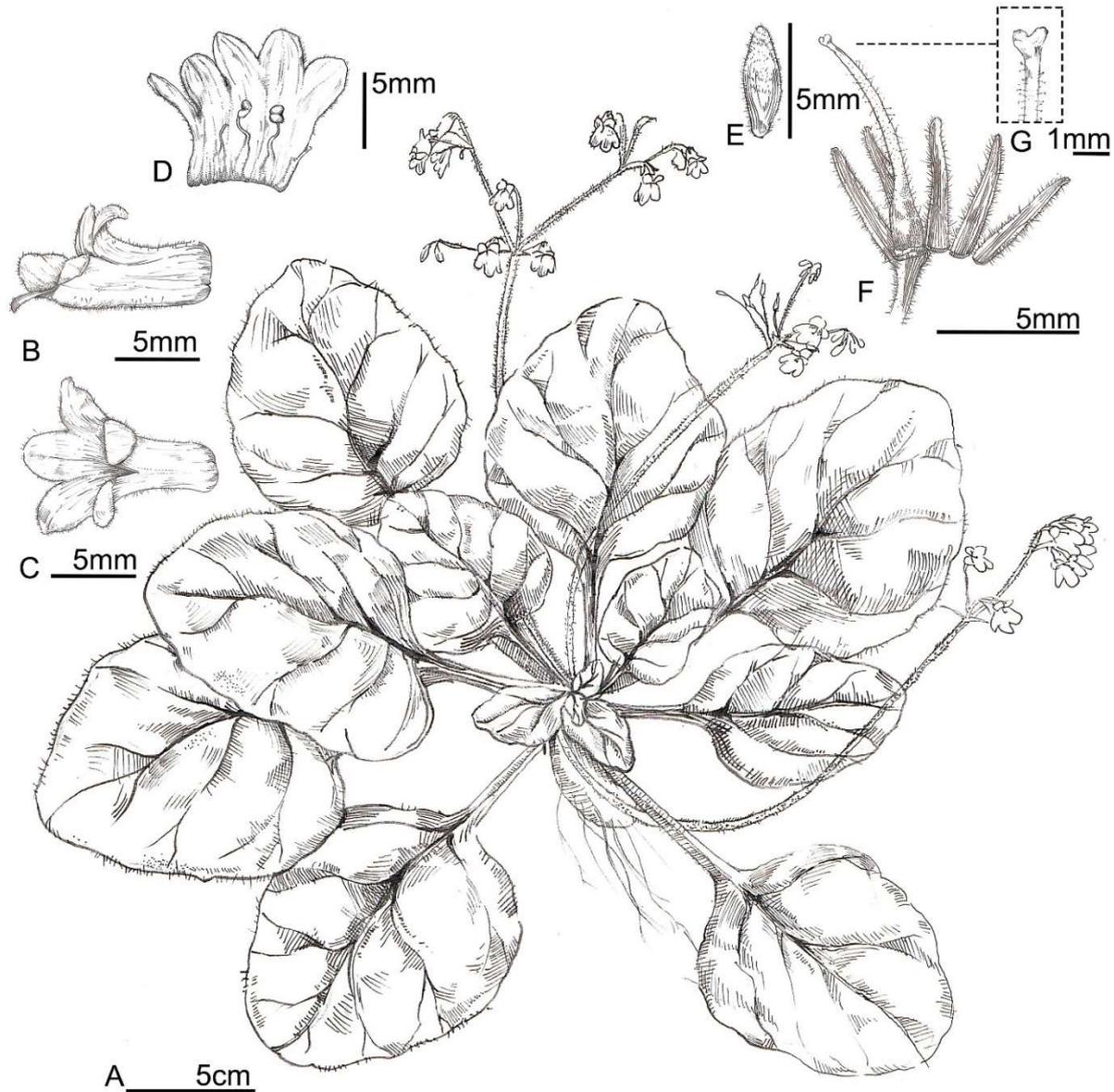


Fig 1. *Primulina alba* R.F. Li & B.Pan A: Habit. B: Front view of the corolla. C: Top view of the corolla. D: Opened corolla. E: The outside surface of bract. F: Pistil and calyx. G: Stigma and style. Drawn by Rui-Feng Li.

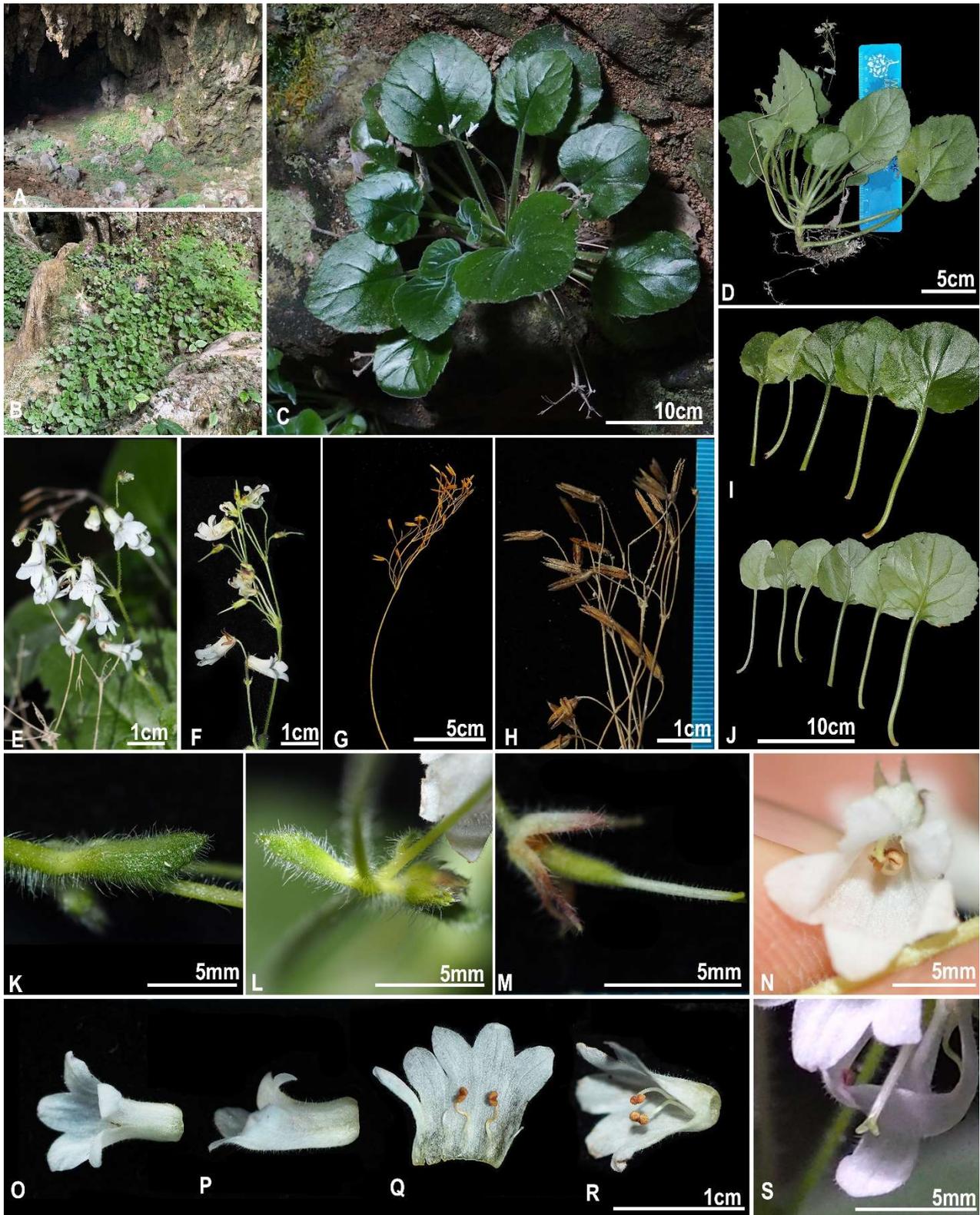
## TAXONOMIC TREATMENT

*Primulina alba* R.F.Li & B.Pan, *sp. nov.*

小白花報春苣苔 Figs. 1 & 2

**Type:** China. Guangxi: Cultivated flowering plant harvested on 16 August 2020 in the Gesneriad Conservation Center of China and National Gesneriaceae Germplasm Resources Bank, Original plant collected from Guangxi Zhuangzu Autonomous Region. Chongzuo City, Tiandeng County, Jinjie Town, Longmang village, on moist limestone rock surfaces in a limestone cave, 23.4297°N, 107.3320°E, alt. ca. 320 m, 09 May 2020, PB200509-01 (**Holotype:** IBK 00445110; **Isotypes:** IBK 00445111; TAI).

**Diagnosis:** *Primulina alba* is morphologically similar to *P. cerina* (Fig. S1), but it differs from the latter in its **Leaf Blade** herbaceous (*vs.* fleshy), broadly ovate, nearly rounded to rounded (*vs.* nearly rounded to cordate rounded), 4–10 × 4–12 cm (*vs.* 3–5.5 × 3.5–5.5 cm). **Corolla** outside sparsely puberulent, inside puberulent (*vs.* outside sparsely extremely short puberulent, inside nearly glabrous). **Stamens** adnate to ca. 2 mm above corolla tube base (*vs.* adnate to ca. 3 mm above corolla tube base). **Filament** ca. 5 mm long (*vs.* ca. 6 mm long in *P. cerina*). **Pistil** 8.5–9 mm long (*vs.* 10.5–11 mm long); **Ovary** narrowly cylindrical (*vs.* ovoid), ca. 4mm × 0.7mm (*vs.* ca. 2.5 × 1 mm), densely erect puberulent *vs.* densely eglandular-puberulent).



**Fig 2.** Photographs of *Primulina alba* R.F. Li & B.Pan **A, B:** Habitat. **C:** Habit. **D:** Plant. **E, F:** Cymes. **G, H:** Infructescences. **I:** Adaxial surface of the leaf blades. **J:** Abaxial surface of the leaf blades. (All leaves are from the same adult plant) **K:** Bracts, abaxially. **L:** Bracts adaxially. **M:** Calyx and pistil. **N:** Front view of the corolla. **O, P:** Top view of the corolla. **Q, R:** Opened corolla showing stamens. **S:** Stigma.



**Description:** Perennial herb. **Rhizome** subterete, 3–4 cm long, ca. 1 cm in diam. **Leaves** 7–25, all basal, petiolate. **Leaf-blades** herbaceous, green, broadly ovate, nearly rounded to rounded, 4–10 cm long, 4–12 cm wide, apex obtuse to rounded, base obliquely cordate, occasionally unequal cordate, margins usually crenate to undulate, both sides densely puberulent with erect white hairs; lateral veins ca. five on each side of the midrib, adaxially main vein conspicuously sunken and lateral veins inconspicuously sunken, abaxially main vein and lateral vein conspicuously raised; petiole 13–18 cm long, densely erect white pubescent. **Cymes** 3–7, ca. 16 cm long, axillary, 3–5-branched, 12–20-flowered. **Peduncle** 10–12 cm long, ca. 1 mm in diam., densely erect white puberulent. **Bracts** 2, opposite, lanceolate to subulate, ca. 4 mm long, ca. 2 mm wide, margin entire, apex acute, both sides densely erect white puberulent; bracteoles 2, opposite, linear-lanceolate, ca. 1.8 mm long, ca. 1 mm wide, margin entire, both sides densely puberulous; third level bracteoles 2, ca. 1 mm long, ca. 0.5 mm wide, shape and indumentum same as bracteoles. **Pedicel** 1–2 cm long, ca. 1 mm in diam., densely erect white puberulent. **Calyx** 5-parted to the base, sepals lanceolate-linear to subulate, ca. 4 mm long, ca. 1 mm wide, both sides densely erect white puberulent. **Corolla** tubular, white, zygomorphic, bilabiate, 1–1.2 cm long; corolla throat not constricted, ca. 5 mm in diam., outside sparsely puberulent, inside puberulent; tube nearly cylindrical, 5.5–6.5 × ca. 4 mm; adaxial lip short, 2-lobed to over middle, lobes oblong, 3.5–4 mm long, 3.2–3.5 mm wide at the base, apex usually rounded but occasionally apex, obtuse to rounded; abaxial lip 3-lobed to over middle, lobes ovate, the central one slightly longer than lateral ones, lobes oblong to rounded, ca. 3 mm long, ca. 3.5 mm wide at the base, lateral lobes oblique, oblong to rounded, ca. 3 mm long, 3.1–3.3 mm wide at the base, apex of all lower lobes usually rounded but occasionally acute, obtuse to rounded. **Stamens** 2, adnate to ca. 2.0 mm above the base of tube; **Filaments** pale yellow to pale brownish yellow, ca. 5 mm long, linear but gradually becoming flat from the middle to the base, slightly geniculate in the middle; **Anthers** reniform, slightly constricted in the middle, both apices slightly blunt, brownish yellow, ca. 1 mm long, ca. 0.5 mm in diam., glabrous. **Staminodes** 2, glabrous, adnate ca. 2.5 mm to the base of the tube, straight, ca. 3 mm long, apex capitate; median adnate to ca. 1.0 mm above corolla base, inconspicuous, ca. 1.0 mm long. **Disc** annular, brownish-yellow, ca. 0.6 mm high, glabrous, margin entire. **Pistil** 8.0–9.0 mm long, included; **ovary** narrowly cylindrical, pale green, densely erect puberulent, ca. 4 mm long, ca. 0.7 mm in diam. in the middle; **style** linear, white, indumentum same as ovary; **stigma** 2-lobed, lobes ovate to inconspicuously triangular, ca. 0.5 mm long, ca. 0.3 mm wide, greenish to yellowish-green. **Capsule** linear-cylindrical, 8–13 mm long, valvular dehiscent, with the passage of time will become 4-

valved, nearly glabrous to glabrous.

**Phenology:** Flowering is from the middle of June to August, and the fruiting is from August to September.

**Etymology:** The specific epithet, ‘*alba*’, is derived from the white color of the small flowers of the new species.

**Distribution and habitat:** *Primulina alba* is hitherto only known from one population on the moist rock face in a Karst cave in Tiandeng County, southwestern Guangxi, China, at altitudes from alt. 300–350 m. *Lysionotus denticulosus* W.T.Wang accompanies the new species, along with *Begonia edulis* Lévl., *Lysimachia saxicola* Chun & F.Chun ex Chen & C.M.Hu, *Spiradiclis longibracteata* S.Y.Liu & S.J.Wei, *Aristolochia versicolor* S.M. Hwang, *Ficus tinctoria* Forst. F., and other plants.

**Additional voucher specimens examined:** *Primulina cerina* F.Wen, Yi Huang & W.C.Chou. CHINA. Guangxi Zhuangzu Autonomous Region, Yizhou City, Beiya Town, Xiaozhudong Village, 24°22' N, 108°23' E, 220m a.s.l., only known from crevices of moist rock surfaces at the entrances of big limestone cave, 3 Apr. 2018, Chou Wei Chun et al., CWC171116-01 (Holotype: IBK! Isotypes: IBK!).

**Preliminary conservation status:** Only one population at one site with ca. 10,000 mature individuals of the new species is known, based on the result of field surveys in the type locality and adjacent regions. This new species was not found within a 10 km radius from the center of the population. Its estimated Area of Occupancy (AOO) is ca. 3000 m<sup>2</sup>. The main threats come from environmental damages caused by local human activities (such as breeding livestock and stacking firewood in the cave), and prolonged natural droughts that cause many plant deaths. Given that only one population of about 10,000 individuals have been found, there is a degree of threat. Thus, *Primulina alba* is provisionally assessed as Vulnerable [VU D1], based on Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2022).

**Notes:** *Primulina alba* sp. nov. is recognized as a new species because it was found to be morphologically different from all the other species of the genus known in China and Vietnam. This judgment is based on extensive field surveys in the South and Southwest China karst areas. The discovery of new species hints that further floristic surveys should be carried out in the South & Southwest China karst areas. Additional new species will be added to the flora of China and limestone flora due to the continuous research on karst area plants (Monro et al., 2018; Ren et al., 2018; Fu et al., 2022). The high species diversity and restricted distributions in limestone habitats have made the calciphilous *Primulina* an ideal study subject for understanding plant radiation on Sino-Vietnamese Limestone Karsts (Xu et al., 2021; Hsieh et al., 2022). Thus, the genus, *Primulina*, displays wide morphological diversity in vegetative and reproductive organs, for example, shapes, sizes, and indumentum of leaf blades; size, color, and indumentum of corollas;



length, shape, and indumentum of the pistil (including styles and ovaries), *etc.* It is well-known that environmental factors significantly influence the vegetative organs of *Primulina*. Therefore, various aspects will be considered in the taxon diagnosis of new species. *P. cerina* is the most morphologically similar to *P. alba*, exhibiting cordate leaves, small corolla, and similar flower numbers, *etc.* Still, the size of the leaves, the corolla's indumentum, and the stamens' position are quite different. The cordate leaf blades are relatively uncommon in *Primulina*. Some species, e.g. *P. cordata* Mich.Möller & A.Weber, *P. hunanensis* K.M.Liu & X.Z.Cai and *P. huaijiensis* Z.L.Ning & J.Wang, and *P. cordifolia* (D.Fang & W.T.Wang) Yin Z.Wang, share this characteristic, but their flowers are of different size, color, and indumentum. Further, *P. cordifolia* has a similar size and shape of leaves but can be distinguished from *P. alba* by the pale yellow to yellow corolla, the two longitudinal red glands inside the corolla, and the apex of limb lobes acute. We also notice that *P. mollifolia* (D.Fang & W.T.Wang) J.M.Li & Yin Z.Wang has a similar shape and size corolla, but the size of leaf blades is obviously smaller, and the purple to pinkish purple corolla can easily distinguish them; while *P. jiangyongensis* X.L.Yu & Ming Li also shares same cordate leaf blades with *P. alba*, but the leaf blade margin is entire, compared to *P. alba* leaf blades margins usually crenate to undulate. The larger sized flowers with the bright yellow corolla also show the distinctive differences.

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