

Primulina hunanensis sp. nov. (Gesneriaceae) from a limestone area in southern Hunan, China

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A new species of Gesneriaceae, *Primulina hunanensis*, is described and illustrated from southern Hunan, China. Morphologically, it is similar to *P. cordata* (= *Chirita cordifolia*), but differs by having much larger leaves, broadly ovate or ovate bracts, 2–12 (–25)-flowers, longer peduncle and purple corolla. It also resembles *P. eburnea* in the shape of the bracts and the colour of the corolla, but can be distinguished by longer petioles (9–25 cm long), cordate, ovate-cordate or broadly ovate leaf lamina with rounded or obtuse apex, not entire leaf margin, and either cordate or deeply cordate leaf base. Detailed morphological description, diagnostic comparisons, habitat and micro-morphology of seeds and pollen under SEM are presented.

Based on the results of a phylogenetic analysis from ITS and *trnL-F* sequences, the formerly monotypic *Primulina* Hance has recently been redefined to contain more than 130 species, including all species of *Chirita* Buch.-Ham. sect. *Gibbosaccus* Clarke and those previously placed in the genera *Chiritopsis* W. T. Wang, *Primulina*, and two species of *Wentsaiboea* D. Fang & D. H. Qin (Weber et al. 2011). Since then, more than twenty new species and varieties have been described in this recircumscribed genus (Liu et al. 2011, Hong et al. 2012, Huang et al. 2012, Li et al. 2012, 2014, Wen et al. 2012a, 2012b, 2012c, 2013, Wu et al. 2012a, 2012b, Xu et al. 2012, 2013, Chung et al. 2013, Jiang and Li 2013, Lu et al. 2013, Ning et al. 2013a, 2013b, Pan et al. 2013, Zhao et al. 2013, Zheng and Deng 2014, Cai et al. 2014, Liang et al. 2014, Wen and Wei 2014, Zhou et al. 2014). *Primulina* is highly diverse in the limestone regions of northern Vietnam and southern China.

During the past three years, a series of expeditions to limestone areas in southern Hunan for the project ‘Floristic survey of Balsaminaceae A. Rich. and Gesneriaceae Dumort.’ have been carried out. On one of these expeditions, we collected specimens of *Primulina* that differs from the other species in this genus. After a morphological study and thorough consultation of relevant literature (Wang et al. 1998, Li and Wang 2004, Wei et al. 2010), we concluded that it represents a new species as described and illustrated below.

***Primulina hunanensis* K. M. Liu & X. Z. Cai sp. nov.**
(Fig. 1–2)

Similar to *P. cordata* Mich. Möller & A. Weber (= *Chirita cordifolia* W. T. Wang) by the shape of the leaf lamina, but

differs in having much larger leaves (11–26 × 9–21 cm), broadly ovate to ovate bracts (3–6 × 2–5 cm), 2–12 flowers, longer peduncle (5–23 cm long) and purple corolla. The new species also resembles *P. eburnea* (Hance) Yin Z. Wang in the shape of the bracts and the colour of the corolla, but can be distinguished by longer petioles (9–25 cm long), cordate, ovate-cordate or broadly ovate leaf lamina with rounded or obtuse apex, not entire leaf margin, and either cordate or deeply cordate leaf base.

Type: China. Hunan Province, Jianghua County, at the entrance of a limestone cave, 24°51′08.31″N, 111°41′35.73″E, 480 m a. s. l., 10 Jun 2012 (flowering and fruiting), K. M. Liu and X. Z. Cai 29988 (holotype: HNNU, isotypes: HIB, HNNU).

Etymology

The specific epithet is derived from the type locality.

Description

Perennial acaulescent herbs. Rhizome subterete, vertical, woody, heavily marked with leaf scars, with long fibrous roots, 2–10 × 0.8–1.5 cm. Leaves 6–10 or more, all basal. Petiole flattened but hemispherical, green or purple-red, 9–25 × 0.4–1.0 cm, with trichomes 2.5–3.5 mm long. Leaf lamina fleshy-leathery or herbaceous when fresh, papery when dry, cordate, ovate-cordate or broadly ovate, 11–26 × 9–21 cm, rounded or obtuse at apex, cordate or deeply cordate at base (young leaf base aequilateral, mature leaf base often oblique), margin repand, shallowly crenate, or occasionally obtusely dentate, both surfaces covered with straight, pointed, white trichomes, especially on the veins and along the margins; lateral veins 4–6 on each

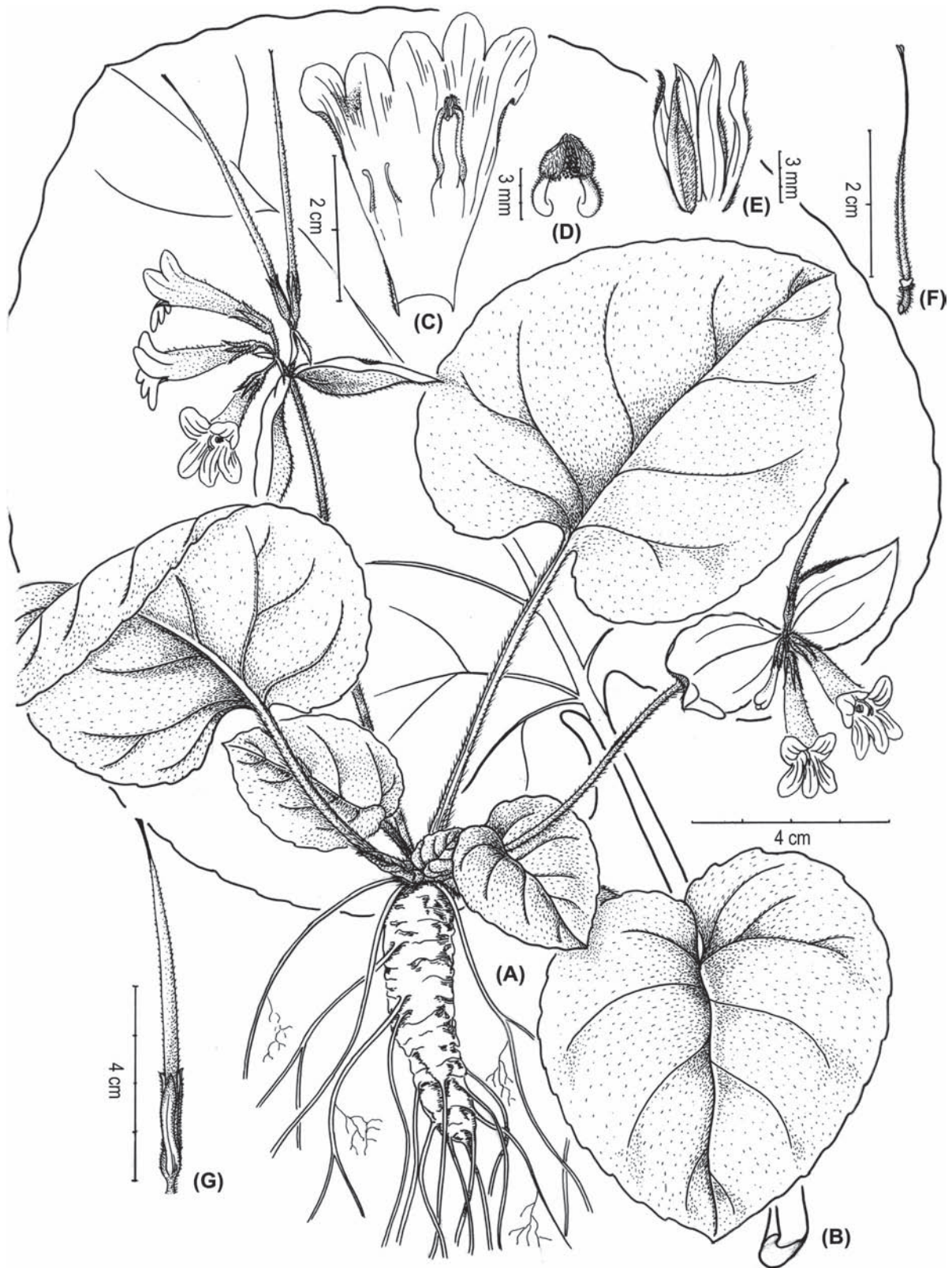


Figure 1. *Primulina hunanensis* sp. nov. (A) habit, (B) leaf, (C) opened corolla exposing stamens and staminodes, (D) stamens, (E) calyx, (F) pistil, (G) capsule. Drawn by Jing Tian from the holotype.



Figure 2. Habitat and morphology of *Primulina hunanensis* sp. nov. (A) habitat, (B) habit, (C) whole plant, (D) adaxial leaf blade surface, (E) flower, front view, (F) flower, side view, (G) anatomical structure of flower, (H) young fruits. Photo by Xiu-Zhen Cai from Jianghua, Hunan.

side of midrib, green or purple-red, inconspicuous adaxially and prominent abaxially. Cymes axillary, 1–6 or more per plant, 1–2-branched, each 2–12-flowered, rarely more than 25-flowered. Peduncle stout, 5–23 cm long, densely covered by white trichomes; Bracts 2, large, opposite, broadly ovate or ovate, 3–6 × 2–5 cm, purple-red or pale green, acute at apex, with entire or repand, rarely crenate margin, adaxially sparsely pubescent from 0.5–1.5 mm long trichomes, abaxially densely pubescent from 1.5–2.5 mm long trichomes, midrib conspicuous. Pedicel 3–15 mm long, densely covered by short trichomes. Calyx 5-parted nearly to base; lobes equal, purple-red, mauve or pale green, narrowly lanceolate, 8–12 × 1.2–3.0 mm, abaxially with dense trichomes, adaxially nearly glabrous, acute at apex, with entire margin, persistent. Corolla purple, throat with distinct white stripes; mouth 3.5–4.0 × 1.0–1.3 cm, outside with dense short trichomes, inside sparsely short glandular below the insertion of the filaments, with white and brown stripes between adaxial and abaxial lobes and between abaxial lobes in the throat, and a brown patch with numerous glandular trichomes on the roof of the mouth inside; tube narrowly funnel-shaped, 2.8–3.5 cm long, almost straight; limb distinctly 2-lipped; adaxial lip 2-lobed to near the base, with lobes broadly oblong, 8.5–9.5 mm long; abaxial lip 3-lobed to near the

middle, with lobes oblong, the central longer than the other two, 9–13 mm long. Stamens 2, adnate to 1.6–1.8 cm above the base of corolla tube; filaments linear, 8–12 mm long, strongly geniculate about 4 mm above the point of attachment, with glandular trichomes; anthers 3.5–4.5 mm long, dorsifixed, fused face to face, with two rows of dense long beards on the adaxial border of each anther-theca; staminodes 2, rarely 3, 7–9 mm long, capitate and curved at apex, adnate to 1.3 cm above the base of the corolla tube, with sparse trichomes below middle (glabrous above). Disc annular, 1.2–1.8 mm high, with repand margin, glabrous. Pistil 2.6–3.8 cm long, 1.8 mm wide at base, narrowing to 1 mm below the stigma, puberulent; style 1.1 cm long, sparsely puberulent; stigma 1.8–2.2 mm long, its apex 2-lobed. Capsule elongate, purple-red or green, slightly curved, 5.5–7.5 × 0.1–0.3 cm, with dense trichomes. Seeds numerous, small, brown, ca 0.4 mm long.

Phenology

Primulina hunanensis has been observed with flowers from May to June, and fruits from June to August.

Vernacular name

China: hunanbaochunjutai.

Table 1. Morphological comparison among *Primulina hunanensis* sp. nov., *P. cordata* and *P. eburnea*.

Characters	<i>P. hunanensis</i>	<i>P. cordata</i>	<i>P. eburnea</i>
Number of leaves	6–10 or more	ca 5	unknown
Petioles (cm)	9–25 × 0.4–1.0	3.0–17.5 × ca 0.2	1–8 × 0.5–1.0
Leaf lamina shape	cordate, ovate-cordate or broadly ovate	ovate to oblate or reniform	ovate to elliptic or obovate
Leaf lamina size (cm)	11–26 × 9–21	2.0–6.8 × 2.0–6.8	3.5–17 × 2.0–9.5
Leaf apex	rounded or obtuse	acute to rounded	acute
Leaf base	cordate or deeply cordate	cordate	attenuate to broadly cuneate
Leaf margin	repand, shallowly crenate, occasionally obtusely dentate	irregularly repand-crenate to dentate or serrate	entire
Lateral veins	4–6 on each side of midrib, not paired	3–5 pairs	4–5 pairs
Cymes	1–6 or more per plant, 1–2-branched	unbranched	unbranched or 1-branched
Number of flowers	2–12 (–25)	1	1–13 (–17)
Peduncle (cm)	5–23	ca 3.5	4–30
Bract shape	broadly ovate or ovate	linear-lanceolate	ovate to orbicular-ovate
Bract size (cm)	3–6 × 2–5	6–9 × 1.0–1.2	1.0–4.5 × 0.8–2.8
Bract margin	entire or repand, rarely crenate	entire	entire
Pedicel (cm)	0.3–1.5	ca 1	to 2.3
Sepal	narrowly lanceolate, adaxially nearly glabrous	linear-lanceolate, adaxially strigose	narrowly lanceolate, adaxially sparsely puberulent
Sepal size (mm)	8–12 × 1.2–3.0	ca 13 × 1.2–1.5	7–10 × 2.0–2.5
Corolla colour	purple, throat with distinct white stripes	pink	purple to white or yellow
Tube (cm)	narrowly funnel-shaped, 2.8–3.5	narrowly funnel-shaped, ca 2.8	narrowly tubular, ca 3
Adaxial lip (mm)	8.5–9.5	ca 7	5–9
Abaxial lip (cm)	0.9–1.3	ca 1.4	1.2–1.8
Filaments	8–12 mm, with glandular trichomes	ca 14 mm, glabrous	9–10 mm, sparsely puberulent basally
Anther	3.5–4.5 mm long, two rows of dense long beards on the adaxial border of each anther-theca	ca 5 mm long, villous	3–5 mm long, nearly glabrous
Staminodes	2 (–3), 7–9 mm long	2, ca 8.5 mm long	2, 4–6 mm long
Flowering time	May–Jun	Jul	Apr–Sep
Fruiting time	Jun–Aug	unknown	May–Oct
Habitat	moist, shady surface of rocks near or in the entrance of limestone caves	among shaded rocks on limestone hills	rocks in forests or along stream sides in forests on limestone hills
Elevation (m a.s.l.)	342–480	ca 200	near to 1900

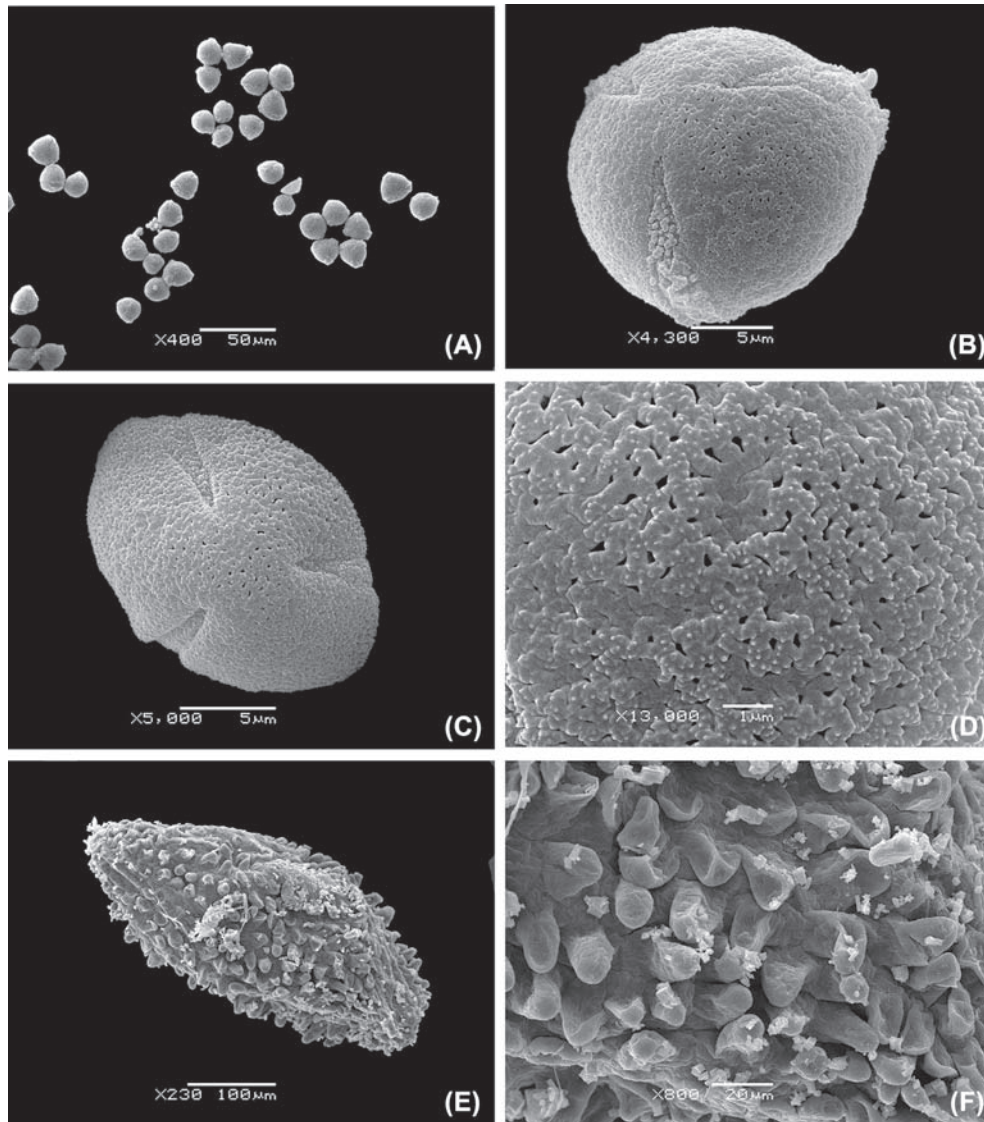


Figure 3. Scanning electron microscope (SEM) photos of pollen and seed of *Primulina hunanensis* sp. nov. (A)–(D) pollen, (A) whole view (showing the shape of pollen grains), (B) equatorial view, (C) polar view (showing 3-colpate), (D) polar view showing exine ornamentation, (E)–(F) seed and testa, (E) overview, (F) testa surface. Voucher specimen: Ke-Ming Liu and Xiu-Zhen Cai 31270.

Distribution and habitat

Primulina hunanensis is currently known only from six sites in Jianghua County, southern Hunan Province, China. It grows on the moist, shady surface of rocks at the entrance of limestone caves on the northern hills, at 342–480 m a.s.l. and shares its habitat with plants such as *Selaginella uncinata* (Desv.) Spring (Selaginellaceae Willk.), *Bauhinia championii* Benth. (Fabaceae Lindl.), *Caesalpinia crista* L. (Fabaceae Lindl.), *Pilea cavaleriei* H. Lévl. (Urticaceae Juss.), *Primulina tabacum* Hance (Gesneriaceae Dumort.), *Petrocodon hancei* (Hemsl.) Mich. Möller & A. Weber (Gesneriaceae Dumort.) and *Impatiens macrovexilla* Y. L. Chen (Balsaminaceae A. Rich.).

Conservation status

Because *P. hunanensis* has been collected from only six sites, the total population size is estimated to be less than 800 mature individuals, and at least 95% of the mature

individuals are found in one subpopulation, we categorize the species as ‘Endangered’ (EN): C2a(ii) (IUCN 2012).

Similar species

A morphological comparison between *Primulina hunanensis* and the most closely related taxa *P. cordata* and *P. eburnea* is provided in Table 1.

Additional specimens examined (paratypes)

China. Hunan Province, Jianghua County, Daxu Town, Zhanggongyan, at the entrance of a limestone cave, 24°47′10.03″N, 111°42′58.41″E, 410 m a. s. l., 14 Jun 2012, K. M. Liu and X. Z. Cai 31246 (HNNU); same locality, 22 Jun 2013, K. M. Liu and X. Z. Cai 31341 (HNNU); Hunan Province, Jianghua County, Daxu Town, Xiaoshuiyan, at the entrance of a limestone cave, 24°47′20.63″N, 111°42′57.78″E, 384 m a.s.l., 23 Jul 2012, K. M. Liu and X. Z. Cai 31270 (HNNU); same locality, 22 Jun 2013, K.

M. Liu and X. Z. Cai 31339 (HNNU); Hunan Province, Jianghua County, Xiaoxu Town, Gujiayan, at the entrance of a limestone cave, 24°55'10.40"N, 111°41'58.62"E, 342 m a.s.l., 24 Jul 2012, K. M. Liu and X. Z. Cai 31284 (HNNU); same locality, 20 Jun 2013, K. M. Liu and X. Z. Cai 31334 (HIB, HNNU); Hunan Province, Jianghua County, Daxu Town, Chuanyan, among shaded rocks on limestone hills, 24°51'35.60"N, 111°41'55.27"E, 409 m a.s.l., 19 Jun 2013, K. M. Liu and X. Z. Cai 31328 (HNNU); Hunan Province, Jianghua County, Daxu Town, Xiangsiyan, at the entrance of a limestone cave, 24°55'12.36"N, 111°41'56.28"E, 382 m a.s.l., 20 Jun 2013, K. M. Liu and X. Z. Cai 31330 (HNNU).

Palynology

Pollen morphology of *P. hunanensis* was observed by scanning electron microscopy (SEM). Pollen grains were found to be single (Fig. 3A), tricolpate, subspheroidal in equatorial view (Fig. 3B) and 3-lobed oblate in polar view (Fig. 3C), $17.6 \times 13.1 \mu\text{m}$. The ornamentation on polar surface of the grain is finely reticulate with small mesh size (Fig. 3D).

Seed micro-morphology

Seeds of *P. hunanensis* are numerous and minute like dust. In general, the seeds of this species are narrowly ellipsoid, brown in color, and $0.40\text{--}0.48 \times 0.17\text{--}0.21 \text{ mm}$ in size (Fig. 3E). The seed testa surface is rough and has an irregularly granular ornamentation throughout. The size of the granolas is variable (Fig. 3F).

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