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Primulina adenopoda (Gesneriaceae)，a new species from the limestone karst area of Jiangxi Province, China

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ABSTRACT: *Primulina adenopoda* (Gesneriaceae) is described and illustrated here. This new species resembles *P. yangshanensis* W.B.Xu & B.Pan and *P. depressa* (Hook.f.) Mich.Möller & A.Weber in leaf blade shape, corolla tube shape, and corolla color; phylogenetic analysis shows it is closely related them too, but it is distinct from them by indumentum characters, bracts number, corolla tube size, and placenta type. The conservation status of *P. adenopoda* is assessed as "Near Threatened" (NT) according to IUCN Red List Categories and Criteria.

KEY WORDS: Flora of Jiangxi, IUCN, *Primulina depressa*, *Primulina yangshanensis*, Taxonomy, Yushiyan Scenic Spot.

INTRODUCTION

Over twelve years ago, the genus *Primulina* (Gesneriaceae) was redefined based on the combined evidence of morphology and phylogenetics. After revision, there were 132 species in the revised genus *Primulina* s.l. at that time (Wang *et al.*, 2011; Weber *et al.*, 2011). Some species, namely *P. cycnostyla* (B.L.Burtt) Mich.Möller & A.Weber, *P. cyrtocarpa* (D.Fang & L.Zeng) Mich.Möller & A.Weber, *P. eberhardtii* (Pellegr.) Mich.Möller & A.Weber, *P. minutihamata* (D.Wood) Mich.Möller & A.Weber and *P. tamiana* (B.L.Burtt) Mich.Möller & A.Weber, were subsequently transferred to *Deinostigma* W.T.Wang & Z.Yu Li (Möller *et al.*, 2016). So, in fact, there are 127 species were included in the 2011 revision. Since then, many new species of *Primulina* have been reported and published every year. As of December 2023, more than 240 species (including infraspecies) have been accepted and published, of which 230 species are distributed in China, making it the largest genus of Gesneriaceae in China at present (Xiong *et al.*, 2022; GRC, 2023). Among the known species of *Primulina* in the world, most of them are endemic species, often only found in limestone niches in South & Southwest China and North Vietnam (Xu *et al*., 2020; Wei *et al*., 2022), especially in Guangxi, which is the origin center and species diversity center of this genus (Wei, 2018).

Jiangxi Province, one of the inland provinces in China, belongs to the subtropical monsoon climate zone. At present, there are 43 species of Gesneriaceae belonging to 15 genera in this province. Of these, there are 13 species of *Primulina* (Peng *et al*., 2021; Xu *et al.*, 2023a,b), with 5 recent publications after 2011 (Ning *et al*., 2014; Zhou *et al*., 2016; Xu *et al*., 2020, 2023a,b). In March 2021, when we conducted a plant survey in Yushiyan Scenic Spot, which is the karst area in the south of Jiangxi Province, we found an unknown species of *Primulina* at the entrance of a limestone cave.

MATERIALS AND METHODS

***Morphological Observation*:** The authors collected and made specimens, carefully observed the living mature individuals and dried specimens of the unknown species, recorded the size, shape, color, and other characteristics of each part, observed the indumentum of the plant under Olympus-ML31 dissecting microscopes (Guangzhou, China) and Olympus-CX33 optical microscope (Nanjing, China). All available specimens of *Primulina* were compared (*viz.,* those stored in the following herbaria: e.g., ANU, HITBC, IBK, IBSC, KUN, PE). Technical terms were used to describe the species following Wang *et al*. (1998) and Li and Wang (2005). The type specimens are preserved in IBK.

Sampling and DNA sequencing: We randomly selected three plants from the population to collect leaves for DNA extraction. Fresh leaf materials were preserved in silica gel for quick drying. Total genomic DNA was extracted from dried leaves using modified cetyl trimethylammonium bromide (CTAB) protocol (Doyle and Doyle, 1987). ITS and *trn*L-F were amplified and sequenced following the methods of Smissen *et al*. (2004) and Möller *et al*. (2009), respectively. In addition, we downloaded the ITS and *trn*L-F sequences from GenBank for 188 *Primulina* species and two *Petrocodon* taxa. Species and GenBank accession numbers employed in this study are listed in Table 1.

Table 1. Species names and GenBank accession numbers of ITS and *trn*L-F DNA sequences used in this study

Species name	Voucher NO.	ITS	*trnL-F*	Species name	Voucher No.	ITS	*trnL-F*
Petrocodon ainsliifolius	*CWH88*	KF202291	KF202298	*P. lobulata*	*GDQX04*	KF498054	KY393519
Petrocodon hancei	*CIPeng22903*	KY796057	KY796059	*P. longgangensis*	*P22948*	JX506916	JX506808
P. adenopoda	*WF218*	OP243288*	OP243284*	*P. longicalyx*	*GXGL01*	KY394927	KY393521
P. alutacea	*YD07*	KY394847	KY393441	*P. longii*	*XWB*	JX506917	JX506809
P. argentea	*YMBC*	KY394848	KY393442	*P. longzhouensis*	*P22963*	JX506918	JX506810
P. baishouensis	*GXLG05*	KY394849	KY393443	*P. lunglinensis*	*GZXY04*	KY394930	KY393524
P. balansae	*BALAN*	MK747141	MK746274	*P. lunglinensis* var. *amblyosepala*	*LCDE*	MK747105	MK746281
P. beiliuensis	*GXBLBC*	KY394850	KY393444	*P. lungzhouensis*	*GXJX10*	KY394931	KY393525
P. beiliuensis var. *fimbribracteata*	*SGQJ04*	KY394851	KY393445	*P. luochengensis*	*LCWCGL01*	KY394932	KY393526
P. bicolor	*SLHLCB*	KY394852	KY393446	*P. lutea*	*1844*	JX506921	JX506813
P. bipinnatifida	*GXLG04*	KY394853	KY393447	*P. lutescens*	*PBLS01*	MK747135	MK746263
P. bobaiensis	*BBGL01*	KY394854	KY393448	*P. lutvittata*	*KFC4149*	MK369978	MK369993
P. bogneriana	*WF7*	MK747166	MK746225	*P. luzhaiensis*	*HYH019*	KC190197	KC190204
P. brachytricha	*DWDMCZ*	KF498048	KY393450	*P. mabaensis*	*SZY02*	KY394937	KY393531
P. brachytricha var. *magnibracteata*	*KFC4193*	MK369979	MK369994	*P. macrodonta*	*GXIB*	JX506923	JX506815
P. brunnea	*BRUN*	MK747142	MK746275	*P. maculata*	*Xu11916*	KU220604	KU220609
P. bullata	*GXJX06*	KF498071	KY393451	*P. maguanensis*	*YNMG*	MK747127	MK746267
P. cangwuensis	*GXLG04*	KY394853	KY393447	*P. malipoensis*	*YNMLP01*	MK747123	MK746240
P. cardaminifolia	*GXLB*	MK747131	MK746255	*P. medica*	*GXPLCM*	KY394940	KY393534
P. carinata	*NTBC*	KY394858	KY393452	*P. melanofilamenta*	*GXXA*	MK747158	MK746277
P. cataractarum	*N1*	MW900263	MW960358	*P. minor*	*WXXH1*	MK747160	MK746290
P. chizhouensis	*JXFY01*	KY394860	KY393454	*P. minutimaculata*	*GXLZ10*	KY394941	KY393535
P. colaniae	*WF8*	MK747167	MK746224	*P. moi*	*SGWY03*	KF498115	KY393536
P. confertiflora	*GDYS05*	MK747101	MK746253	*P. mollifolia*	*GXESWC*	KY394943	KY393537
P. cordata	*HYH010*	KC190200	KC190207	*P. multifida*	*DLXHGL01*	KY394946	KY393540
P. cordifolia	*GXRA02*	KY394863	KY393457	*P. nandanensis*	*GXJX02*	KY393541	KY393541
P. cordistigma	*GDYCXZ*	MK747118	MK746251	*P. napoensis*	*GXIB*	JX506930	JX506821
P. crassirhizoma	*CJGL01*	KY394864	KY393458	*P. ningmingensis*	*NMGL01*	KY394949	KY393543
P. crassituba	*HNSP*	MK747147	MK746230	*P. obtusidentata*	*GZJK01*	KF498096	KY393544
P. curvituba	*GXHJ01*	MK747137	MK746242	*P. ophiopogoides*	*GXFS01*	KF498062	KY393545
P. danxiaensis	*P22865*	JX506886	JX506778	*P. orthandra*	*ZRBC2*	MK747128	MK746286
P. debaoensis	*DBGL01*	KY394868	KY393462	*P. parvifolia*	*GGSL01*	KY394952	KY393546
P. depressa	*DXS02*	KY394869	KY393463	*P. pengii*	*W0397*	KU220603	KU220610
P. dryas	*HKDMS*	KY394875	KY393469	*P. petrocosmeoides*	*SHDBC*	KY394953	KY393547
P. diffusa	*PJGL01*	KY394871	KY393465	*P. pinnatifida*	*MS02*	KY394954	KY393548
P. dongguanica	*DGBC*	KY394872	KY393466	*P. polycephala*	*GDLZ06*	KY394955	KY393549
P. drakei	*YNCP01*	KY394873	KY393467	*P. porphyrea*	*DNGL01*	KU173793	KU173799
P. duanensis	*DABC*	KY394877	KY393471	*P. pseudoeburnea*	*KY394958*	KY394958	KY393552
P. eburnea	*P22908*	JX506891	JX506783	*P. pseudoglandulosa*	*GXYS06*	KF498138	KY393482
P. effusa	*KFC4167*	MK369976	MK369991	*P. pseudoheterotricha*	*XWB*	JX506933	JX506824
P. fengkaiensis	*KFC4130*	MK369975	MK369990	*P. pseudolinearifolia*	*JXY*	MK747140	MK746280
P. fengshanensis	*KFC4195*	MK369970	MK369985	*P. pseudomollifolia*	*JMMXH1*	MK747134	MK746244
P. fimbrisepala	*P22863*	JX506894	JX506786	*P. pseudoroseoalba*	*JFHGL01*	KY394959	KY393553
P. fimbrisepala var. *mollis*	*GXIB*	JX506895	JX506787	*P. pteropoda*	*HNCJ01*	KY394960	KY393554
P. flavimaculata	*KFC3988*	MK369974	MK369989	*P. pungentisepala*	*JEGL01*	KY394962	KY393556
P. floribunda	*DHGL01*	KY394886	KY393480	*P. purpurea*	*ZHGL01*	KY394964	KY393558
P. fordii	*LJM1207202*	MG727881	MG727878	*P. qingyuanensis*	*GDQX01*	KY394965	KY394965
P. fordii var. *dolichotricha*	*DHS01*	MK747125	MK746247	*P. renifolia*	*GXDA02*	KY394966	KY393560
P. gemella	*GEME*	MK747146	MK746254	*P. repanda*	*GXBM03*	KY394968	KY393562
P. glabrescens	*GZLBSM*	MK747132	MK746278	*P. ronganensis*	*GXRA01*	KF498135	KY393564
P. glandaceistriata	*GXLCHW*	MK747114	MK746256	*P. rongshuiensis*	*GXRS01*	KF498088	KY393565
P. glandulosa	*GXPLCG*	KY394887	KY393481	*P. roseoalba*	*LDGL01*	KY394972	KY393566
P. gongchengensis	*GCGL01*	KY394889	KY393483	*P. rosulata*	*GXPL05*	KU528874	KU528884

P. grandibracteata	*YNHK*	MK747121	MK746266	*P. rotundifolia*	*OO3*	KY394975	KY393569
P. guigangensis	*GXGGBC*	KY394892	KY393486	*P. rubribracteata*	*JH01R*	KU173791	KU173797
P. guihaiensis	*GXLG036*	KY394893	KY393487	*P. sclerophylla*	*GXDA01*	KY394979	KY393573
P. guizhongensis	*GXGZBC*	KY394894	KY393488	*P. secundiflora*	*GZQZ*	MK747119	MK746279
P. halongensis	*HLW01*	KY394895	KY393489	*P. shouchengensis*	*GXYF02*	KY394980	KY393574
P. hedyotidea	*XWB*	JX506905	JX506797	*P. sichuanensis*	*SCBC*	MK747162	MK746264
P. heterochroa	*GXMES01*	KY394898	KY393492	*P. sinovietnamica*	*Peng21956*	MK369973	MK369988
P. heterotricha	*HNBT01*	KY394899	KY393493	*P. sinensis*	*GDSZ01*	KF498055	KF498164
P. hezhouensis	*HZXH*	MK747143	MK746258	*P. spinulosa*	*GXFS02*	KF498063	KY393576
P. hiepii	*WF2*	MK747144	MK746223	*P. subrhomboidea*	*GXYS02*	KY395018	KY393577
P. hochiensis	*GXIB*	JX506903	JX506795	*P. subulata*	*GDYA01*	KY395020	KY393579
P. huaijiensis	*GDHJ02*	KF498127	KY393495	*P. subulata* var. *guilinensis*	*GXHYXH*	KY394967	KY393561
P. huangii	*WF12*	MK747138	MK746231	*P. subulatisepala*	*CQAYH01*	MK747122	MK746246
P. hunanensis	*Xu11697*	KU220602	KU220608	*P. suichuanensis*	*GDLC07*	KY395021	KY393580
P. jiangyongensis	*HNJY01*	KY394902	KY393496	*P. swinglei*	*GXRX01*	KY395022	KY393581
P. jingxiensis	*LZXHGL01*	KY394903	KY393497	*P. tabacum*	*LZ01*	KY395023	KY393582
P. jiuwanshanica	*JWS*	MK747116	MK746260	*P. tenuifolia*	*GXBM01*	KY395024	KY393583
P. juliae	*LJM1210011*	MG727889	MG727873	*P. tenuituba*	*GZGY01*	KY395025	KY393584
P. juliae	*CZYX03*	KY394904	KY393498	*P. tiandengensis*	*GXTD03*	KY395027	KY393586
P. juliae	*SMYA02*	KY394906	KY393500	*P. tribracteata*	*GXFS04*	KY395028	KY393587
P. langshanica	*LSCZ*	KY394907	KY393501	*P. tribracteata* var. *zhuana*	*1877*	JX506952	JX506843
P. latinervis	*XIN1*	KY394908	KY393502	*P. tsoongii*	*ZSGL01*	KY395029	KY393588
P. laxiflora	*P22927*	JX506910	JX506802	*P. varicolor*	*GXNP01*	KF498086	KY393589
P. lechangensis	*GDLC12*	KY394910	KY393504	*P. verecunda*	*LBJX01*	KY395031	KY393590
P. leeii	*LSGL01*	KY394911	KY393505	*P. versicolor*	*GDYD01*	MK747155	MK746252
P. leiophylla	*GXJX07*	KY394912	KY393506	*P. vestita*	*QZXT*	MK747156	MK746282
P. lepingensis	*JXLP01*	KY394913	KY394913	*P. villosissima*	*QXY01*	KY395032	KY393591
P. leprosa	*GXMS055*	KY394914	KY393508	*P. wenii*	*WENI*	MK747148	MK746284
P. lianpingensis	*CHLT016*	MH343910	MH344542	*P. wentsaii*	GXLZ047	KY395033	KY393592
P. liboensis	*GXJX08*	KY394917	KY393511	*P. wuae*	WSBC	MK747159	MK746265
P. liguliformis	*GXIB*	JX506912	JX506804	*P. xinningensis*	GGGL01	KY394891	KY393485
P. lijiangensis	*GLS01*	KY394919	KY393513	*P. xiziae*	ZJHZ01	KY395038	KY393597
P. linearicalyx	*KFC4141*	MH032854	MH032841	*P. yangchunensis*	GDYC01	KY395039	KY393598
P. linearifolia	*GXNN01*	KY394921	KY393515	*P. yangshanensis*	GDNX01	KY395040	KY393599
P. lingchuanensis	*LCXHGL01*	KY394922	KY393516	*P. yangshuoensis*	GXYS07	KY395042	KY393601
P. linglingensis	*LLBC*	KY394923	KY393517	*P. yingdeensis*	YD03	KU528876	KU528886
P. linglingensis var. *fragrans*	*XHLLBC2*	MK746285	MK746285	*P. yungfuensis*	GXIB	JX506957	JX506848
P. liujiangensis	*LJGL01*	KY394924	KY393518	*P. zhoui*	WF18	MK747104	MK746222

* The GenBank accession numbers of ITS and *trn*L-F DNA sequences of WF218-2 and WF218-3 are the same of WF218

Phylogenetic analysis: We assembled and aligned the newly obtained sequences along with those from GenBank using MAFFT v.7.017 (Katoh *et al*., 2002) and subsequently corrected both ends of ITS and trnL-F sequences, to make them same length, combined them in Geneious 9.1.4 (Kearse *et al.*, 2012). We used the Maximum Likelihood (ML) and Bayesian Inference (BI) approaches for the phylogenetic analysis. The ML analyses were conducted using IQ-TREE 1.6.12 (Nguyen *et al*., 2015) with the GTR+R6 model and 1000 ultrafast bootstrap replicates (Xu *et al.*, 2023a). Bayesian Inference analyses were conducted with MrBayes 3.2.6 (Ronquist *et al.,* 2012) with two runs of four Markov chain Monte Carlo (MCMC) chains, ten million generations with one tree sampled every 1000 generations and the first 25% of trees were discarded as burn-in.

RESULTS

The morphology of this unknown species looked similar to *P. yangshanensis* W.B.Xu & B.Pan (Guo *et al*., 2015), which is also distributed in the karst area of northern Guangdong. It was also similar to *P. depressa* (Hook.f.) Mich.Möller & A.Weber (Wang *et al.*, 1990, 1998; Weber *et al.*, 2011), which only grows in the Danxia Landform of northern Guangdong. There are many similarities in their morphological characteristics, for example, they corolla color are purple to bluish purple, corolla tube funnelform-tubular, leaf blade ovate, leaf blade base cuneate and margin serrate, bracts linear-lanceolate, calyx lobes entire, and so on. We used molecular data to confirm its phylogenetic position, unsurprisingly, the position of this species is very close to

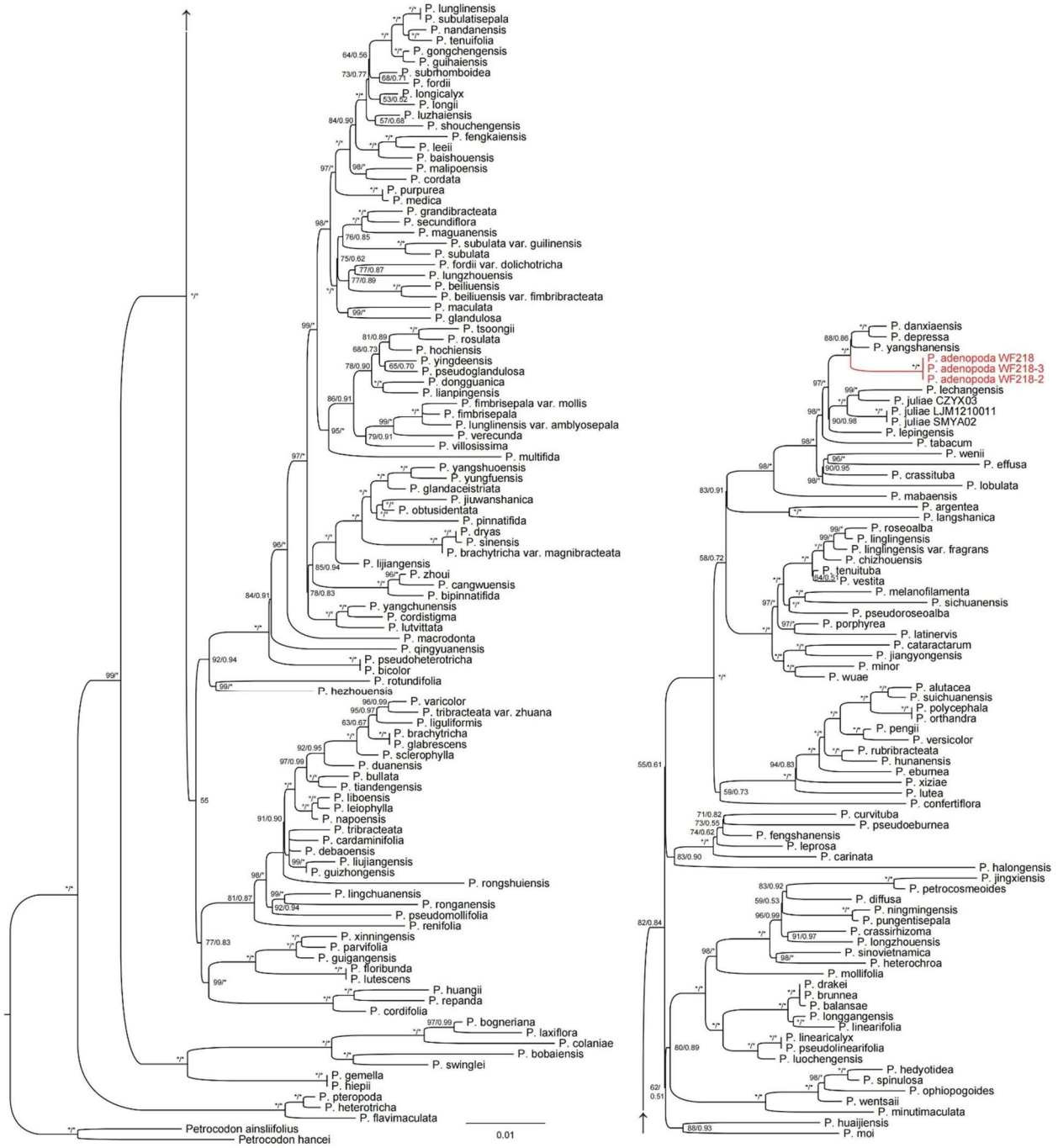

Fig. 1. Phylogenetic gene tree of ***Primulina*** generated from maximum likelihood (ML) of trnL-F and ITS data-set. ML bootstrap support (MLBS) values on the left of "/" and the posterior probabilities of Bayesian inference (BIPP) on the right of "/" are indicated near nodes, stars "*" indicates MLBS=100% and BIPP=1.00. Newly described species in red, namely P. adenopoda.

that of *P. yangshanensis* and *P. depressa*. Nonetheless, there are differences between the two plants morphological characteristics of the petiole, leaf blade, bracts, filaments, placenta type, and corolla tube. Therefore, combined with the evidence of morphology and molecular biology, we consider that this *Primulina* species is new to science and named as *P. adenopoda*.

Phylogenetic analysis showed that *Primulina adenopoda* was sister to the combined clade of *P. danxiaensis* (W.B.Liao, S.S.Lin & R.J.Shen) W.B.Liao & K.F. Chung (Shen *et al*., 2010; Xu *et al*., 2012), *P. depressa* and *P. yangshanensis*. (Fig. 1).

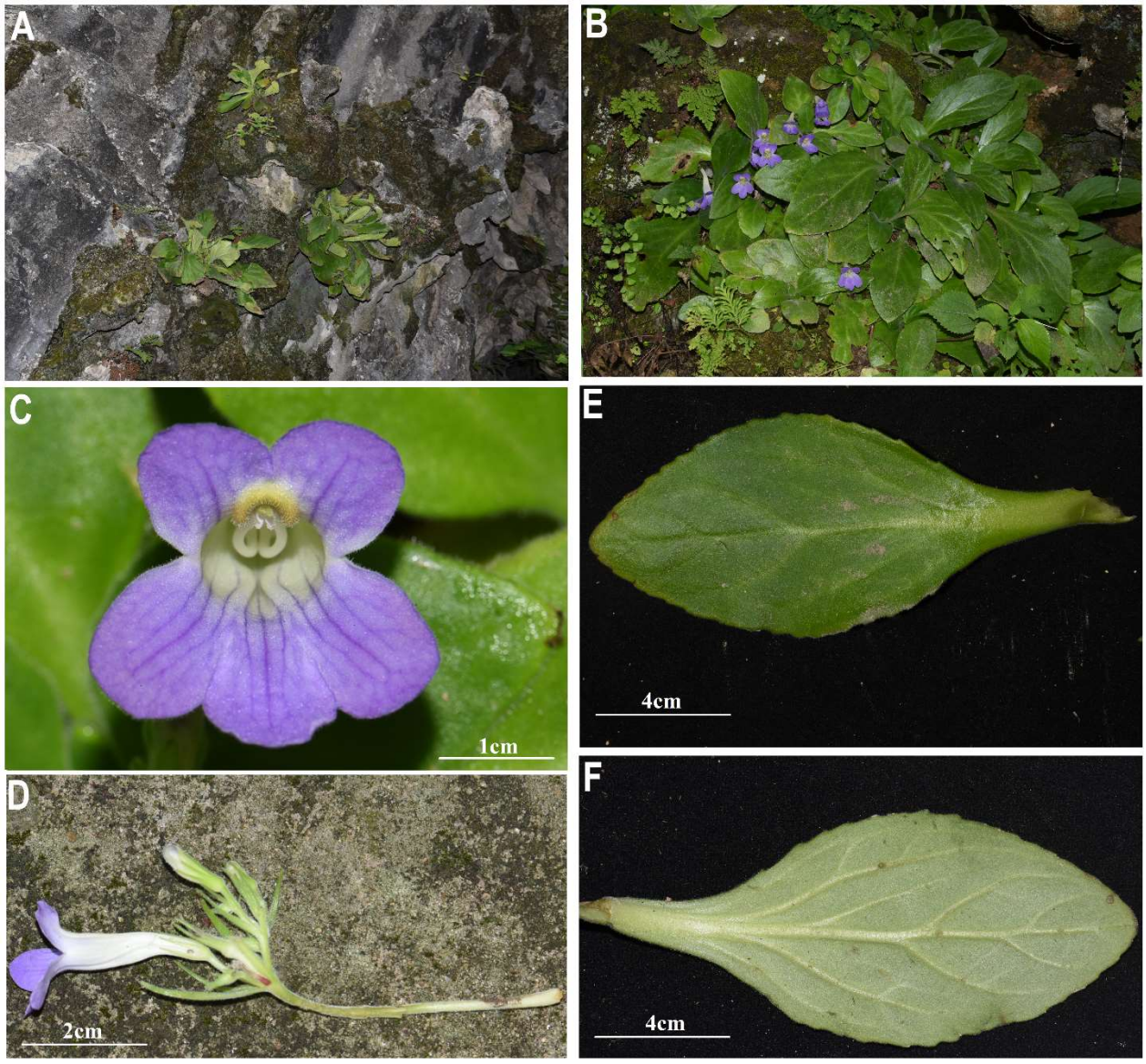

Fig. 2. ***Primulina adenopoda*** sp. nov. **A.** habitat; **B.** habit; **C.** flower; **D.** leaf adaxial; **E.** leaf abaxial; **F.** inflorescence

TAXONOMIC TREATMENT

Primulina adenopoda G.L.Xu, ***sp. nov.***

Figs. 2 & 3

Type: CHINA. Jiangxi Province, Longnan City, Yuyan Township, Yushiyan Scenic Spot, 24°56'13.99"N, 114°47'49.36"E, altitude ca. 225 m, growing at the entrance of a limestone cave, 27 June, 2022, Guo–Liang Xu, *JLSXGL20220627* (*holotype*: IBK!, *isotype*: KUN!).

Diagnosis: *Primulina adenopoda* are similar to *P. yangshanensis* and *P. depressa* morphologically. However, it can be easily distinguished from *P. yangshanensis* by its corolla tube 3.7–4.1 cm long, with a yellowish-brown mark between two adaxial lobes inside (*vs*. 1.4–1.7 cm long, without mark in *P. yangshanensis,* following order same); bracts 3 (*vs*. 2); filaments sparsely glandular-puberulent (*vs*. glabrous). It differs from *P. depressa* (Hance, 1883; Wang *et al.*, 1990, 1998; Li and Wang, 2005; Weber *et al.*, 2011) by parietal placenta (*vs*. axile placenta in *P. depressa*, following order same); bracts 3 (*vs*. 2); filaments sparsely glandular-puberulent (*vs*. glabrous).

Description: Herbs perennial, stems terete, 2–3 cm long, 7–15 mm across. Leaves basal, 4–9, petiolate; petiole green to slightly yellowish green, applanate, 3–10 cm long, 6–13 mm across, densely covered with pubescence and intermixed with glandular-pubescence; leaf blade green, slightly fleshy to thickly chartaceous, ovate, elliptic-ovate to oblong-ovate, 4–20 × 3–9 cm, apex acuminate to obtuse, base cuneate to broadly cuneate, margin obtusely serrate to undulate, both surfaces densely covered with pubescence and intermixed with glandular-pubescence; lateral veins 4–6 on each side,

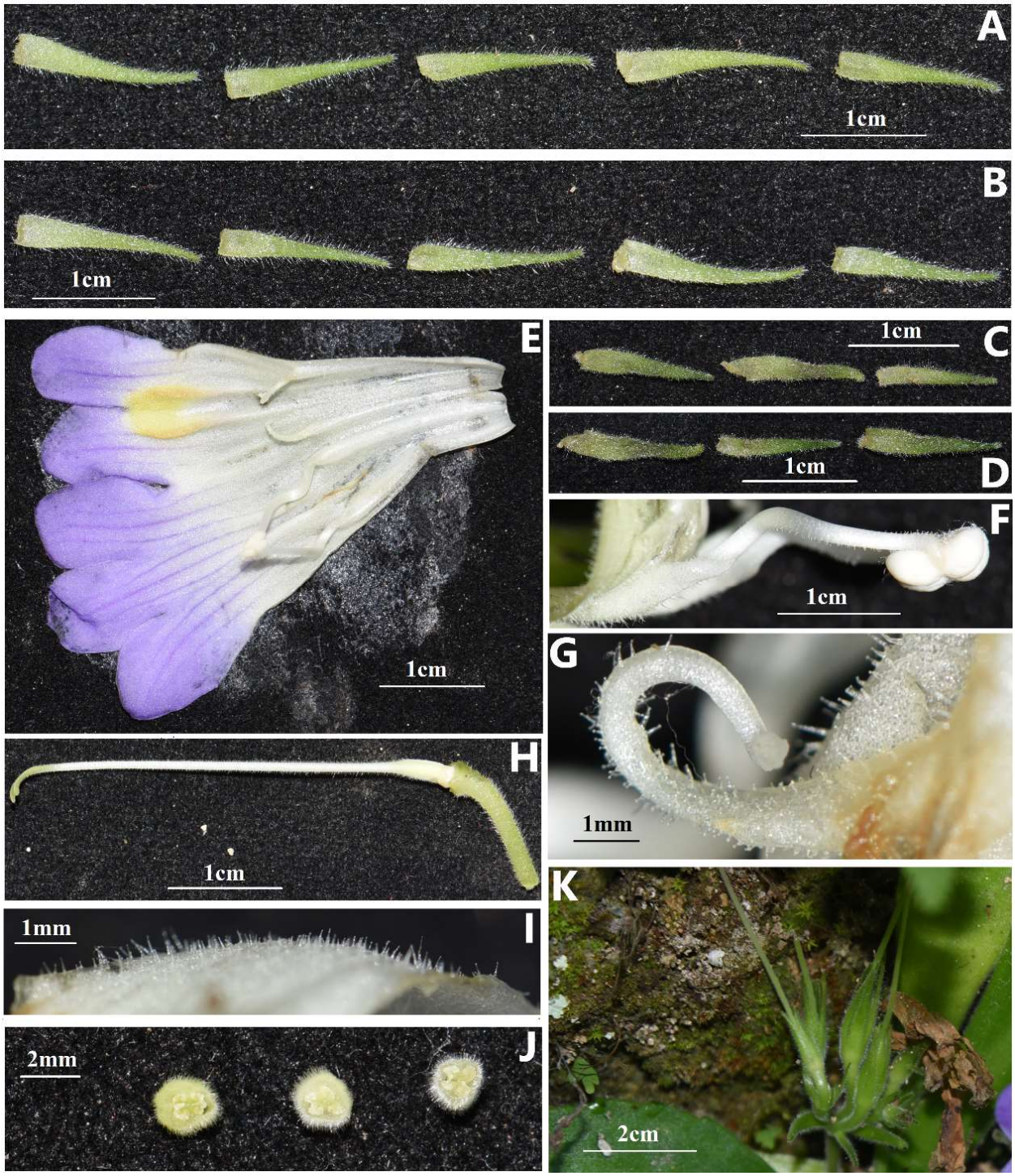

Fig. 3. ***Primulina adenopoda*** sp. nov. **A.** abaxial surface of calyx lobes; **B.** adaxial surface of calyx lobes; **C.** abaxial surface of bracts; **D.** adaxial surface of bracts; **E.** corolla anatomy; **F.** stamens; **G.** staminodes; **H.** pistils (sepals removed); **I.** short glandular hairs in corolla tube; **J.** cross-section of ovary; **K.** immature capsules

conspicuously adaxially impressed and abaxially prominent. Cymes 2–4, 1–3-branched, 3–8-flowers per cyme; peduncle pale green, 4–10 cm long, ca. 1.2 mm across, covered with spreading pubescence and intermixed with sparse glandular-pubescence; pedicel pale green to green, 15–20 mm long, indumentum as peduncle. Bracts 3, pale green to green, unequal, verticillate, all linear-lanceolate to nearly linear, two bigger ones opposite, 12–30 × 1.5–4 mm, the middle one smaller, 10–25 × 1–2.5 mm, both surfaces covered with

Table 2. Comparison of morphological characteristics between ***Primulina adenopoda***, ***P. yangshanensis*** and ***P. depressa***.

Characters	*Primulina adenopoda*	*P. yangshanensis*	*P. depressa*
Petiole and leaf blade indumentum	Both surfaces covered with pubescence and intermixed with glandular-pubescence	Both surfaces pubescent	Adaxially densely puberulent, abaxially velutinous
Bracts number	3	2	2
Corolla			
Corolla tube	3.7–4.1 cm long, with a mark between two adaxial lobes inside	1.4–1.7 cm long, without a mark between two adaxial lobes inside	Ca. 2.3 cm long,with a mark between two adaxial lobes inside
indumentum	Outside covered with puberulent hairs and intermixed with glandular -puberulent hairs, inside glandular-puberulent from the middle to lower part but upper part nearly glabrous	Outside pubescent, inside sparsely puberulent	Outside sparsely pubescent, inside glandular -puberulent below stamens
Filaments indumentum	Sparsely glandular-puberulent	Glabrous	Glabrous
Placenta type	Parietal placenta	Parietal placenta	Axile placenta

pubescence and intermixed with sparse glandular-pubescence, margin entire; bracteoles and secondary bracteoles often 3, tertiary bracteoles usually only 1, all of which the same shape, indumentum, and color as bracts, 5–20 × 0.5–1.5 mm, and smaller. Calyx 5-parted to the base, lobes pale green to green, linear-lanceolate, nearly equal in size and shape, 15–20 × 1–1.5 mm, margin entire, outside spreading pubescent, inside covered with sparse pubescence and intermixed with sparse glandular-pubescence. Corolla 3.8–4.5 cm long, pale purple to bluish purple, with blue-purple stripes inside, two obvious longitudinal ridges at the entrance of mouth between abaxial lobes, a yellowish-brown mark on the dorsum of corolla tube between two adaxial lobes and covered with glandular-puberulent hairs, outside covered with puberulent hairs and intermixed with glandular-puberulent hairs, inside glandular-puberulent from the middle to lower part but upper part nearly glabrous; corolla tube bluish white to almost white, funnelform-tubular, 3.7–4.1 cm long, ca. 1 cm in diameter at mouth, ca. 4 mm in diameter at the base; limb distinctly 2-lipped, bluish-purple to purple, adaxial lip 2-lobed, lobes broadly ovate to semicircular, 8–10 mm long, 7–9 mm wide at the base; abaxial lip 3-lobed, lateral lobes broadly ovate and the middle one oblong, 10–12 mm long, 8–10 mm wide at the base; stamens 2, adnate at 1.7–2 cm above corolla tube base; filaments white, 1.3–1.6 cm long, linear but gradually inflated from the middle to the base and becoming lamellate at the base, geniculate at the middle, sparsely glandular-puberulent; anthers reniform, ca. 5 mm long, ca. 2 mm wide, dorsifixed, adaxial and lateral glabrous but abaxial surface covered with dense villi and intermixed with sparse glandular-pubescence; staminodes 3, white, lateral ones 5–7 mm long, adnate to 1.7–2 cm above the base of corolla tube, linear, apex capitate, sparsely glandular-puberulent, the middle one ca. 2 mm long, adnate to ca. 1 cm above the base of corolla tube; disc annular, ca. 1 mm high, margin undulate. Pistil 3.7–4 cm long, style 3.3–3.6 cm long, ca. 1 mm in diameter, covered with puberulent hairs and intermixed with glandular-puberulent hairs, ovary narrowly ovoid, ca. 4 mm long, ca. 2 mm in diameter, parietal placenta, covered with dense pubescence and intermixed with sparse glandular-pubescence; stigma ca. 3 mm long, obtriangular, the apex 2-lobed, lobes narrowly oblong to linear. Capsule 1.5–2 cm long, narrowly oblong, covered with dense pubescence and intermixed with sparse glandular-pubescence.

Distribution and habitat: We only found one population on the sides of the limestone cave entrance in the Yushiyan Scenic Spot in Yuyan Township, Longnan City, Jiangxi Province, China. Companion species were calcareous herbs such as *Eremochloa ciliaris* (L.) Merr., *Hypodematium crenatum* (Forssk.) Kuhn, *Adiantum lianxianense* Ching & Y.X.Lin and *A. capillus-veneris* L.

Etymology: The petiole of this new species covered with dense pubescence and intermixed with glandular-pubescence, so the specific epithet is derived from the indumentum characters of petiole, namely "*adenopoda*".

Phenology: Flowering from June to August, fruiting from July to October.

Vernacular name: **腺柄报春苣苔** (Chinese name); Xiàn Bǐng Bào Chūn Jù Tái (Chinese pronunciation).

Provisional conservation status: *Primulina adenopoda* is only known from one population of about 250 mature individuals at the type locality, Yushiyan Scenic Spot, Longnan city, Jiangxi Province, China. The current situation of this population is stable at present, because the habitat is protected by the administrator of this scenic location. The EOO and AOO of the new species are about 0.2 km^2 and 25 m^2, respectively. Thus, if considering its fewer individuals in one population, it should be temporarily assessed as Near Threatened [NT], following the IUCN Red List Categories and Criteria (IUCN, 2022).

Note: The type locality of *Primulina yangshanensis* and *P. depressa* is situated in Yangshan County and Renhua County, Guangdong Province, respectively (Wang *et al.*, 1990, 1998; Li and Wang, 2005; Weber *et al.*, 2011; Guo *et al*., 2015), their type locality are only 180 kilometres and 90 kilometres away from the type locality of *P. adenopoda*, respectively. Phylogenetic

analysis shows that they are closely related too, but their morphological differences support that *P. adenopoda* is a new species. Detailed comparisons of these three species are provided in Table 2.

Based on a detailed comparison with the other thirteen species of *Primulina* which is distributed in Jiangxi Pronvince (Wang *et al.*, 1990, 1998; Li and Wang, 2005, 2017; Wen *et al*., 2014), a identification key to these fourteen species is provided.

1. Bracts 3. 2
- Bracts 2. 7
2. Petiole, leaf blade, bracts coverd with glandular hairs. 3
- Petiole, leaf, bracts with no glandular hairs 5
3. Both side of leaf blade pubescent and glandular-pubescent, calyx lobes entire . . . . . ***P. adenopoda***
- Both side of leaf blade villous and glandular-pubescent, each side of calyx lobes with several crenate at apex 4
4. Collora tube funnelform. .. . . . . ***P. jiulianshanensis***
- Collora tube curved-tubular. . . .. ***P. arcuata***
5. Outside Corolla puberulent, stigma 3-lobed . . . . . ***P. lepingensis***
- Outside Corolla glandular-puberulent, stigma 2-lobed 6
6. Leaf blade, bracts, calyx lobes, peduncle villous and pubescent ….. ***P. wenii***
- Leaf blade, bracts, calyx lobes, and peduncle pubescent …… ……..…….. ***P. xinningensis***
7. Corolla throat with few to many purple spots inside …… ……..…….. ***P. fimbrisepala***
- Corolla throat with no purple spots inside 8
8. Staminodes 2. 9
- Staminodes 3. 12
9. Leaf blade margin lobed 10
- Leaf blade margin not lobed 11
10. Leaf blade base cordate, filaments glabrous .. . . . . ***P. danxiaensis***
- Leaf blade base cuneate, filaments glandular-puberulent ….. ***P. pinnatifida***
11. Corolla tube obviously swollen, bracts rhombic. . . . ***P. dongguanica***
- Corolla tube not swollen, bracts lanceolate-linear. ... . ***P. juliae***
12. Corolla tube obviously inflated, upper throat of corolla tube with no lump inside . . . . ***P. inflata***
- Corolla tube not inflated, upper throat of corolla tube with a mark inside. 13
13. Leaf blade margin entire, parietal placenta. .. . . . . ***P. suichuanensis***
- Leaf blade crenate, axile placenta . . . . . ***P. depressa***

***Additional specimens examined (paratype)*:** CHINA. Jiangxi Province: Longnan City, Yushiyan Scenic Spot, 24°56'13.92"N, 114°47'49.26"E, altitude 255 m, moist and rocky places of the limestone cave entrance, 24 July, 2022, *JLSXGL20220724* (IBK).

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