

An expansion of the genus *Deinostigma* (Gesneriaceae)

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ABSTRACT. Based on molecular, morphological and cytological studies the previously monotypic genus *Deinostigma* W.T.Wang & Z.Y.Li has been expanded to include several species previously ascribed to *Primulina* Hance. *Deinostigma* now comprises seven species, including one previously placed in synonymy. The new combinations *Deinostigma cicatricosa* (W.T.Wang) D.J.Middleton & Mich.Möller, *Deinostigma cynostyla* (B.L.Burt) D.J.Middleton & H.J.Atkins, *Deinostigma cyrtocarpa* (D.Fang & L.Zeng) Mich.Möller & H.J.Atkins, *Deinostigma eberhardtii* (Pellegr.) D.J.Middleton & H.J.Atkins, *Deinostigma minutihamata* (D.Wood) D.J.Middleton & H.J.Atkins and *Deinostigma tamiana* (B.L.Burt) D.J.Middleton & H.J.Atkins are made. *Deinostigma eberhardtii* is lectotypified. The genus is defined by a combination of an alternate leaf arrangement, hooked hairs on many plant parts, flowers with the pedicel inserted at an angle and off-centre on the receptacle, and, where known, a somatic chromosome number (2n) of < 36. This new circumscription of the genus expands its distribution from Vietnam into South China.

Keywords. Molecular phylogeny, ovary morphology, *Primulina*, taxonomy

Introduction

The genus *Deinostigma* W.T.Wang & Z.Y.Li in the Gesneriaceae currently has only one species, *D. poilanei* (Pellegr.) W.T.Wang & Z.Y.Li from the southern Annamite range of Vietnam. It was erected as a genus to accommodate the species first described as *Hemiboea poilanei* Pellegr. This species was placed in *Hemiboea* C.B.Clarke due to its bilocular ovary and the perception that one of the locules was sterile, a trait of the species in *Hemiboea*. Wang & Li (1992) argued that it did not belong in *Hemiboea* due to having alternate leaves, free bracts, inside of corolla glabrous, filaments broader

in the upper half, anthers hairy, anther locules divaricate with apices confluent, disc absent, and stigma bifid. In further arguments they noted how it differed from other Asian genera and concluded that a new genus was necessary to accommodate it. Since then, the status and relationships of *Deinostigma poilanei* have remained obscure due to being known from only very few specimens and because relatively little research has been done on the Gesneriaceae of Vietnam.

During work at the Muséum National d'Histoire Naturelle in Paris for an as-yet-unpublished checklist of the Gesneriaceae of Cambodia, Laos and Vietnam by DJM, it became clear that *Deinostigma poilanei* was similar to a number of species from Vietnam and China that were moved into *Primulina* Hance from *Chirita* Buch.-Ham. ex D.Don by Weber et al. (2011), namely *P. cynostyla* (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. None of these *Deinostigma*-like species were included in the molecular phylogenetic analyses by Weber et al. (2011) but were moved into *Primulina* based on their previous inclusion in *Chirita* sect. *Gibbosaccus* C.B.Clarke by Wood (1974). All species of the hitherto *Chirita* sect. *Gibbosaccus* that were included in the molecular analyses formed a single highly supported clade with *Primulina tabacum* Hance, the type of *Primulina* (Weber et al., 2011).

Deinostigma poilanei and the species of *Primulina* similar to it share a number of morphological traits that are not found in other species of *Primulina*. These are alternate leaf arrangement (opposite or verticillate in the remaining *Primulina* species), hooked hairs on many plant parts but particularly on the pedicels, and flowers with the pedicel inserted at an angle and off-centre on the receptacle. In several species the fruit is strongly curved. The alternate leaf arrangement is not particularly clear in the species with a congested rosette of basal leaves but is nevertheless observable by only a single leaf emerging from the apical meristem at a time. Differences also exist in the basic chromosome numbers, with *Primulina* having exclusively $x = 18$ (> 100 species counted out of > 150 described) (Möller & Pullan, 2015 onwards) while one *Deinostigma*-like species, *P. tamiana*, has been counted with $x = 16$ (Christie et al., 2012). In other features the plants are indeed similar to *Primulina*. It should also be noted that these *Deinostigma*-like *Primulina* species occur on a variety of substrates but not on limestone and that the majority of the remaining *Primulina* species occur on limestone substrates.

In Wang et al. (1998) *Chirita cicatricosa* W.T.Wang is placed in synonymy of *C. minutihamata* D.Wood (= *Primulina minutihamata*), typified by material from China and Vietnam respectively. We found that the material from China has longer, more slender and more falcate fruits and somewhat larger flowers than material from Vietnam. Coupled with their large disjunct distribution, and pending a revision of the species, we suspect that they may represent distinct species and treat them thus here (see also below).

The aim of this study was to investigate the relationship between *Deinostigma* and *Primulina* and clarify the status of the *Deinostigma*-like *Primulina* species.

Materials and Methods

Plant materials

Herbarium specimens and living collections of *Deinostigma poilanei* and the *Deinostigma*-like *Primulina* species were studied in the Royal Botanic Garden Edinburgh and the Muséum National d'Histoire Naturelle in Paris.

Materials for morphological and phylogenetic analyses were collected in Vietnam (*Deinostigma poilanei*, *Primulina tamiana*) and China (*Primulina cyrtocarpa*, *Chirita cicatricosa*) (Table 1). Data for the phylogenetic analyses were downloaded from GenBank (including one additional sample of *Primulina minutihamata* from China which we are treating here as *Chirita cicatricosa*). These basically represented a reduced matrix of Old World Gesneriaceae as presented in Middleton et al. (2015). Altogether 132 samples (129 species) were included, covering all 32 genera currently recognised in the subtribe Didymocarpaceae of tribe Trichosporeae (Möller et al., 2009, 2011, 2014; Weber et al., 2013; Middleton et al., 2014a, 2015). The sampling included 20 samples of 19 species of *Primulina*, including the type, *P. tabacum* (Table 1). The phylogenetic trees were rooted on samples of *Microchirita* (C.B. Clarke) Yin Z. Wang (Möller et al., 2009, 2011).

DNA extraction, PCR and phylogenetic analysis

Sequences of the nuclear ribosomal internal transcribed spacers (ITS) and the plastid *trnL*-F intron-spacer (*trnL*-F) for four samples, *Chirita cicatricosa*, *Deinostigma poilanei*, *Primulina cyrtocarpa*, and *P. tamiana*, were obtained. The extraction of genomic DNA was carried out using a CTAB procedure (Doyle & Doyle, 1987, 1990).

The PCR amplification of ITS and *trnL*-F were performed using primers '5P' (5'-GGA AGG AGA AGT CGT AAC AAG G-3') and '8P' (5'-CAC GCT TCT CCA GAC TAC A-3') (Möller & Cronk, 1997) and 'c' (5'-CGA AAT CGG TAG ACG CTA CG-3') and 'f' (5'-ATT TGA ACT GGT GAC ACG AG-3') (Taberlet et al., 1991), respectively, run on a Biorad T100™ Thermal Cycler (Hemel Hempstead, UK). The 10 µL reactions contained 1 µL 10× NH₄ reaction buffer (Bioline, UK), 1 µL dNTPs (2 mM), 0.3 µL MgCl₂ (50 mM), 0.4 µL of each primer (10 µM), 5.6 µL ddH₂O, 0.1 µL Biotaq polymerase (5U/µL) (Bioline, UK) and 1.2 µL DNA template. The PCR thermocycle profile for ITS started with an initial denaturation for 3 min at 94°C, followed by 30 cycles of 1 min at 94°C, 1 min at 55°C and 1.5 min at 72°C, finished with a final extension step for 5 min at 72°C. For *trnL*-F it was: initial denaturation for 4 min at 94°C, followed by 30 cycles of 45 s at 94°C, 45 s at 55°C and 3 min at 72°C, with a final extension step for 10 min at 72°C. PCR products were run on 1% agarose gels to check for amplification success and quality. PCR amplified fragments were purified using ExoSAP-IT (Affymetrix, UK) following the manufacturer's protocol, and sequenced using the dideoxy chain-termination method. Sequencing samples were prepared using the BigDye Terminator v3.1 Cycle Sequencing Kit (Thermo Fisher Scientific, UK) following the manufacturer's recommendations, and sequencing was carried out by the Edinburgh Genomics sequencing service (University of Edinburgh,

UK). Editing and assemblage of sequencing results were performed using the programs Sequencher 4.5 (Gene Codes Corp, Ann Arbor, USA). The newly acquired sequences were added to the reduced matrix of Middleton et al. (2015) and the matrices realigned manually. They were subsequently submitted to GenBank (Table 1).

Since the combinability of the ITS and *trnL*-F matrices, tested with the ILD test (Farris, 1995a, 1995b), implemented as PHT in PAUP* 4.0a146 (Swofford, 2002), did not indicate incongruent phylogenetic signals ($P = 0.58$), the two matrices were analysed together. The reconstruction of phylogenetic trees by maximum parsimony (MP) and Bayesian inference (BI), including the calculation of bootstrap (BS) and posterior probability (PP) branch support values, were carried out as previously described (Möller et al., 2009, 2011; Weber et al., 2011; Middleton et al., 2015): the MP analysis on the combined data was carried out in PAUP* v.4.0b10 (Swofford, 2002), on unweighted and unordered characters. Alignment gaps were treated as missing data. Starting trees were found by parsimony ratchet (Nixon, 1999), in PAUPRat (Sikes & Lewis, 2001) and PAUP*, and the saved trees further optimised in PAUP*, with both TBR and Multrees on. Statistical branch support was obtained from 10,000 heuristic bootstrap replicates each starting with a random addition tree, optimized with TBR on and Multrees off in PAUP* (Möller & al., 2009, 2011).

The BI analyses were run in MrBayes v.3.1.2 (Huelsenbeck & Ronquist, 2001; Huelsenbeck et al., 2007). Models and parameter prior settings were obtained independently for the *trnL*-F, the ITS spacers and 5.8S sequences using MrModeltest v.2.3 (Nylander, 2004), and were GTR + I + G for *trnL*-F and the ITS spacers, and SYM + I + G for the 5.8S gene, respectively, as suggested by the Akaike Information Criterion (AIC; Akaike, 1974). Five million generations were run in two independent analyses each with four Markov chain Monte Carlo (MCMC) chains. One tree was sampled every 1000th generation (= 5000 trees), and the first 250 trees (5%) discarded as burn-in, determined after plotting the generations against the Log(n) likelihoods and a majority rule consensus tree construct with the 'sumt' command and posterior probabilities (PP) obtained in MrBayes.

Cytology

The chromosome numbers for *Deinostigma poilanei* (R. Rybková HB 222) and *Primulina cyrtocarpa* (M.Möller & Y.G. Wei MMO 06-908) (Table 1), were determined from root tips as previously described (Jong & Möller, 2000; Christie et al., 2012). For *Chirita cicatricosa* (Zulin 131585, China, Guangxi, Shangsi), leaf cuttings were cultivated in pots at the South China Botanical Garden, Chinese Academy of Sciences. Actively growing root tips were harvested and pretreated in the dark with 0.1% colchicine and 0.1% 8-Hydroxyquinoline (1:1) at room temperature for 3 hours and then fixed in 3 : 1 absolute ethanol : glacial acetic acid at 4°C for 2 hours. They were macerated in a mixture of 1 : 1 1M HCl and 45% acetic acid at 37°C in a water bath for 45 min, and stained and squashed in 1% aceto-orcein.

Results and Discussion

Phylogeny

The MP analysis resulted in 204 most parsimonious trees with a length of 4123 steps, CI of 0.3772 and RI of 0.6797. For the BI runs, the average standard deviation of split frequencies was 0.003949 indicating a strong convergence of the two runs. Furthermore, a close correlation of the PP values between the two runs was observed, confirming the reproducibility of the runs.

In both the MP (Fig. 1) and BI (Fig. 2) phylogenetic trees, *Primulina* s.s. (excluding *Chirita cicatricosa*, *P. cyrtocarpa*, and *P. tamiana*) forms a highly supported clade (BS = 100%; PP = 1), and, most importantly, is the sister clade to *Petrocodon* with maximum branch support (BS = 100%; PP = 1). *Deinostigma poilanei*, together with *Chirita cicatricosa*, *Primulina cyrtocarpa* and *P. tamiana*, forms a separate clade (BS = 73%; PP = 0.88), which is sister to the monotypic *Metapetrocosmea* W.T.Wang with maximum branch support (BS = 100%; PP = 1). Although most of the genera are in highly supported clades, as in previous studies (Möller et al., 2009, 2011), the backbone of the phylogenetic tree is not resolved. However, since both *Primulina* s.s. and the *Deinostigma* clade form strongly supported sister relationships to other genera respectively, it is unlikely that the two genera are closely related. Consequently, we transfer the *Deinostigma*-like *Primulina* species to *Deinostigma* and refer to them thus hereafter.

Morphology

All species are herbs. They are all probably perennial and, judging from the numerous leaf scars on the stems of some species, they are likely to be deciduous in the dry season. In particular, *Deinostigma cynostyla* has a thick stem with numerous congested leaf scars. The other species have a relatively thin stem and species such as *Deinostigma minutihamata* are mostly procumbent.

All species have an alternate leaf arrangement although this is not so obvious in *Deinostigma cynostyla* where the leaves are very congested. The alternate leaf arrangement is in contrast to *Primulina* s.s. where the leaves are opposite or in whorls, usually of three. The leaf blade is ovate to elliptic with a weakly (*Deinostigma tamiana*) to strongly (*D. cyrtocarpa*) crenate or dentate margin. In all species the length of the petiole is very variable within an individual, but compared to most other Asian genera, it is generally long in proportion to the length of the leaf blade, and often longer than the blade.

The inflorescences arise from the axils of the upper leaves, are borne on long peduncles, and are dichasia with the typical paired-flower arrangement of the Gesneriaceae. They are few-flowered in most species to many-flowered in *Deinostigma eberhardtii*. In most species the inflorescence is fairly lax but is rather congested in the terminal branches in *Deinostigma cynostyla*. There are hooked hairs on the pedicels, which are not found in *Primulina* s.s.

The corolla is white, blue or variations on purple (or combinations of these), infundibuliform, with the lower lip 3-lobed and the upper lip 2-lobed. From the colour and morphology bee pollination is likely.

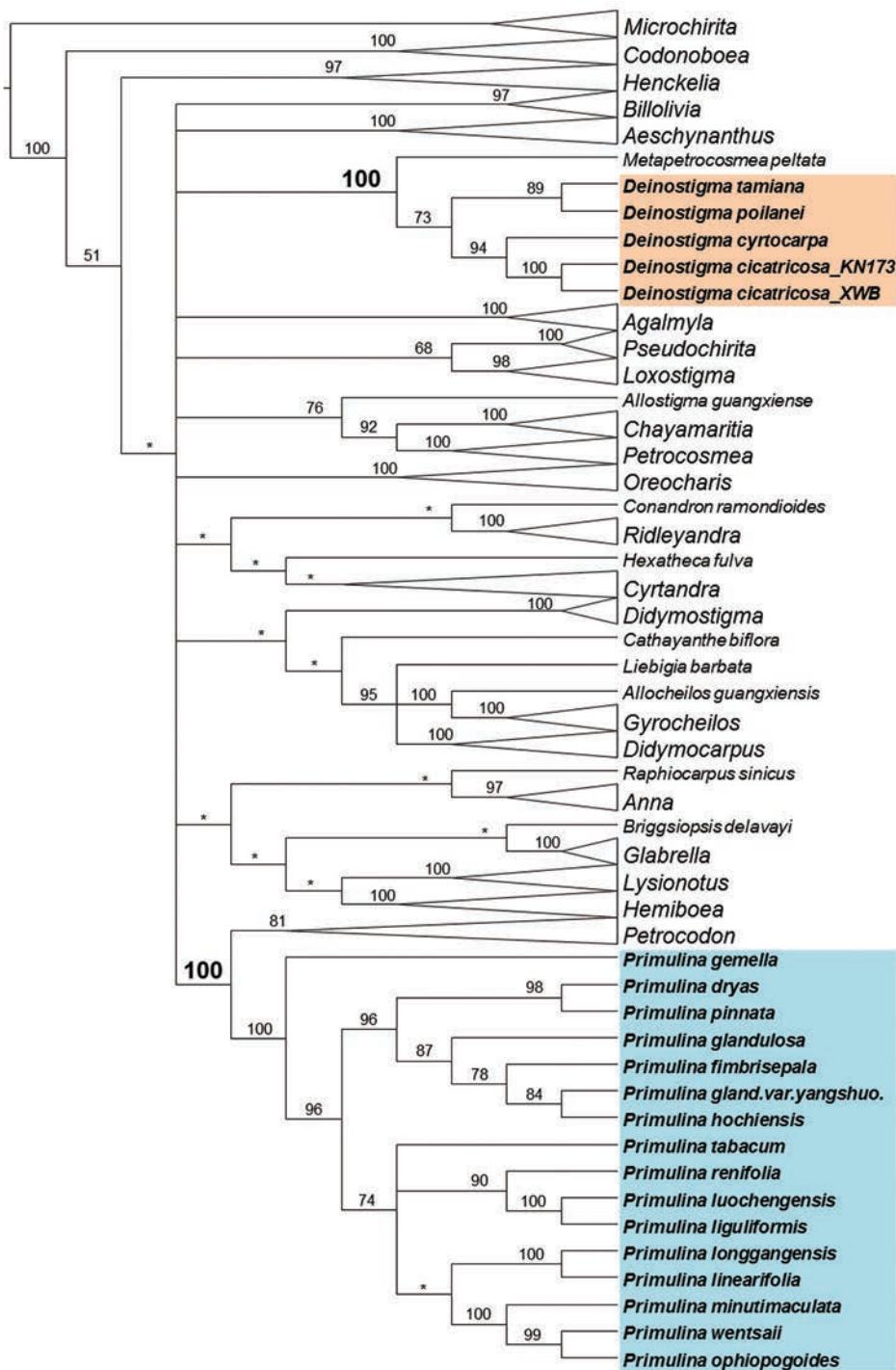


Fig. 1. Maximum parsimony strict consensus tree based on combined ITS and *trnL-F* sequence data. Clades representing entire genera are collapsed. Numbers along the branches are bootstrap values. Asterisks denote branches receiving < 50% support.

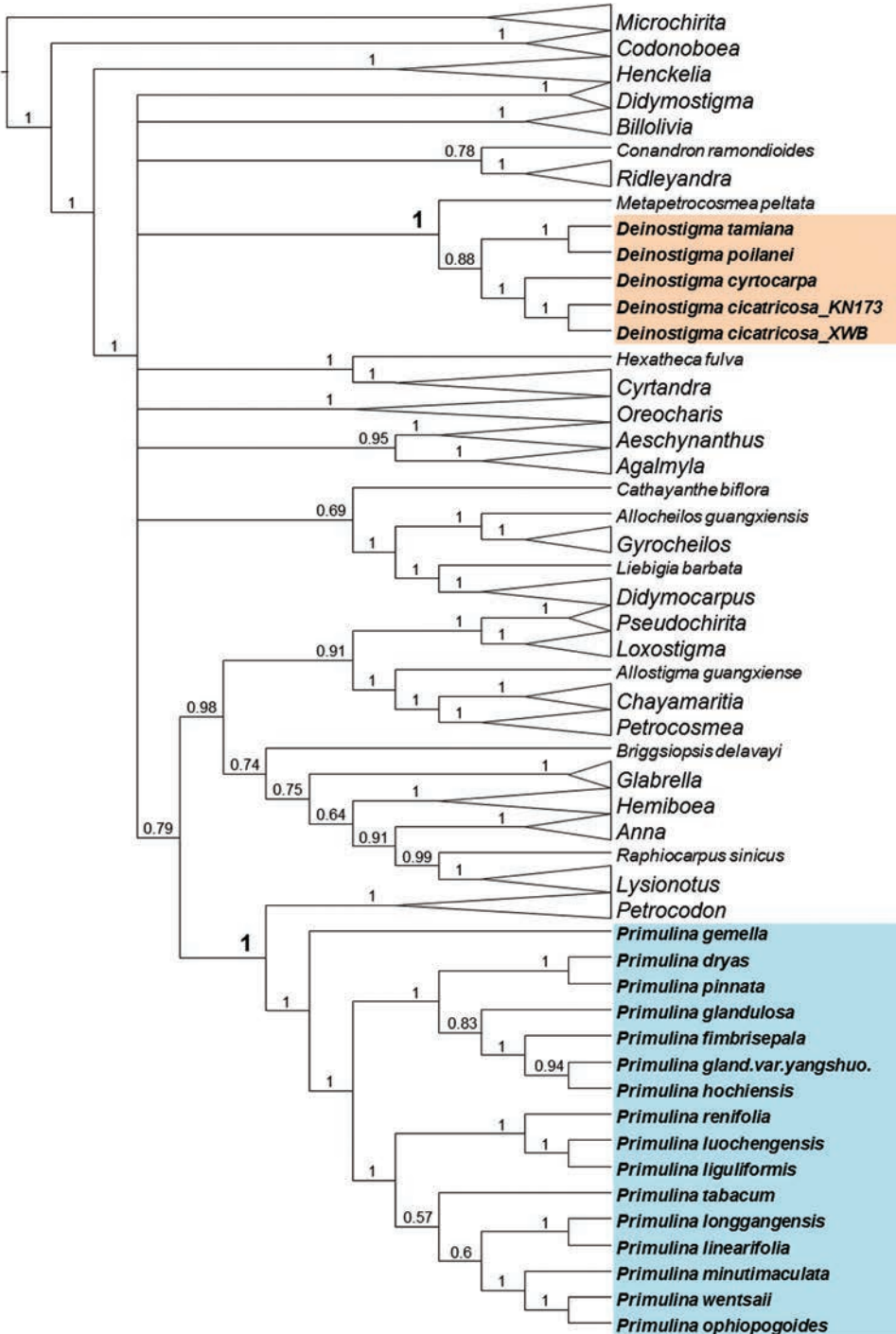


Fig. 2. Bayesian inference majority rule consensus tree based on combined ITS and *trnL-F* sequence data. Clades representing entire genera are collapsed. Numbers along the branches are posterior probability values. Asterisks denote branches with < 0.5 posterior probability.

There are two fertile stamens and three staminodes (the central one sometimes obscure). The filaments are geniculate around the middle and glandular or hairy distally. The anthers are hairy or glandular in all species.

The ovary of *Deinostigma poilanei* is small, c. 5 mm long, at an oblique or sometimes almost a right angle to the pedicel and slightly curved upwards, similar to *D. cynostyla* (c. 2.4 mm long), *D. eberhardtii* (c. 4.5 mm long), *D. tamiana* (c. 5.5 mm long) and *D. cyrtocarpa* (7–9 mm long). At maturity, the capsules in *Deinostigma poilanei*, *D. tamiana* and *D. cyrtocarpa* are 1.5–2 cm long and in *D. eberhardtii* 2.5–2.9 cm long. In these species, the capsules are falcate and inserted at an angle to the pedicel to be carried \pm horizontally (not known in *Deinostigma cynostyla*).

In *Deinostigma cicatricosa* and *D. minutihamata*, the ovary is much larger, c. 12–18 mm long, and only at a slight angle in relation to the pedicel. In *Deinostigma cicatricosa*, the mature capsule is 4.5–5 cm long, has a slight curve and is slender, while in *D. minutihamata*, the capsule remains straight, 2.3–3.5 cm long, and is broader. In all *Deinostigma* species where it is known the capsule dehiscence is loculicidal.

The internal structure of the ovaries could not be studied in all species. In the species studied the internal structure varies considerably. In *Deinostigma poilanei* it is bilocular for its entire length, with axile recurved bifid placentation (Fig. 3A). In *Deinostigma tamiana* and *D. cicatricosa* only the basal part is bilocular while in the middle and distal parts the carpels are not fused and the ovary is unilocular (Fig. 3B, C). We surveyed other species previously within the circumscription of *Chirita*, and now included in other genera (i.e., *Henckelia dielsii* (Borza) D.J.Middleton & Mich. Möller, *Microchirita prostrata* J.M.Li & Z.Xia, *Primulina hochiensis* (C.C.Huang & X.X.Chen) Mich.Möller & A.Weber and *Primulina liguliformis* (W.T.Wang) Mich. Möller & A.Weber), and found them to possess a unilocular ovary for their entire length (Fig. 3E–G). The exception was *Primulina dryas* (Dunn) Mich.Möller & A.Weber, the ovary of which is bilocular throughout but with the abaxial locule being sterile (Fig. 3D).

Chromosome numbers

The chromosome number of *Deinostigma poilanei* and *D. cicatricosa* was determined as $2n = 32$, that of *D. cyrtocarpa* as $2n = c. 30$ (Fig. 4). For all species, the chromosomes within each complement did not differ significantly in size and were c. 0.8–1.2 μm in length. *Deinostigma tamiana* was counted previously as $2n = 32$ (Christie et al., 2012).

The counts for all other *Primulina* species to date (139 counts for 118 species and 4 varieties, Möller & Pullan, 2015 onwards) were uniformly $2n = 36$, except for a tetraploid count of $2n = 72$ for one accession of *P. longgangensis* (W.T.Wang) Y.Liu & Y.Z.Wang (Christie et al., 2012) and one count of $2n = 28$ for the same species (Cao et al., 2003), the latter likely erroneous since two other counts of *P. longgangensis* showed $2n = 32$ (Liu et al., 2012; Kang et al., 2014). Overall, the chromosome size of species of *Primulina* s.s. is slightly larger than those with $2n = c. 30$ and 32 chromosomes, being mostly up to 1.6 μm long, with the exception of *P. aff. balansae* (Drake) Mich. Möller & A.Weber with chromosomes up to 2.0 μm long. Overall, the chromosome numbers are in full congruence with the phylogeny, separating *Primulina* s.s. with $2n = 36$ from those with $2n = c. 30$ and $2n = 32$ chromosomes.

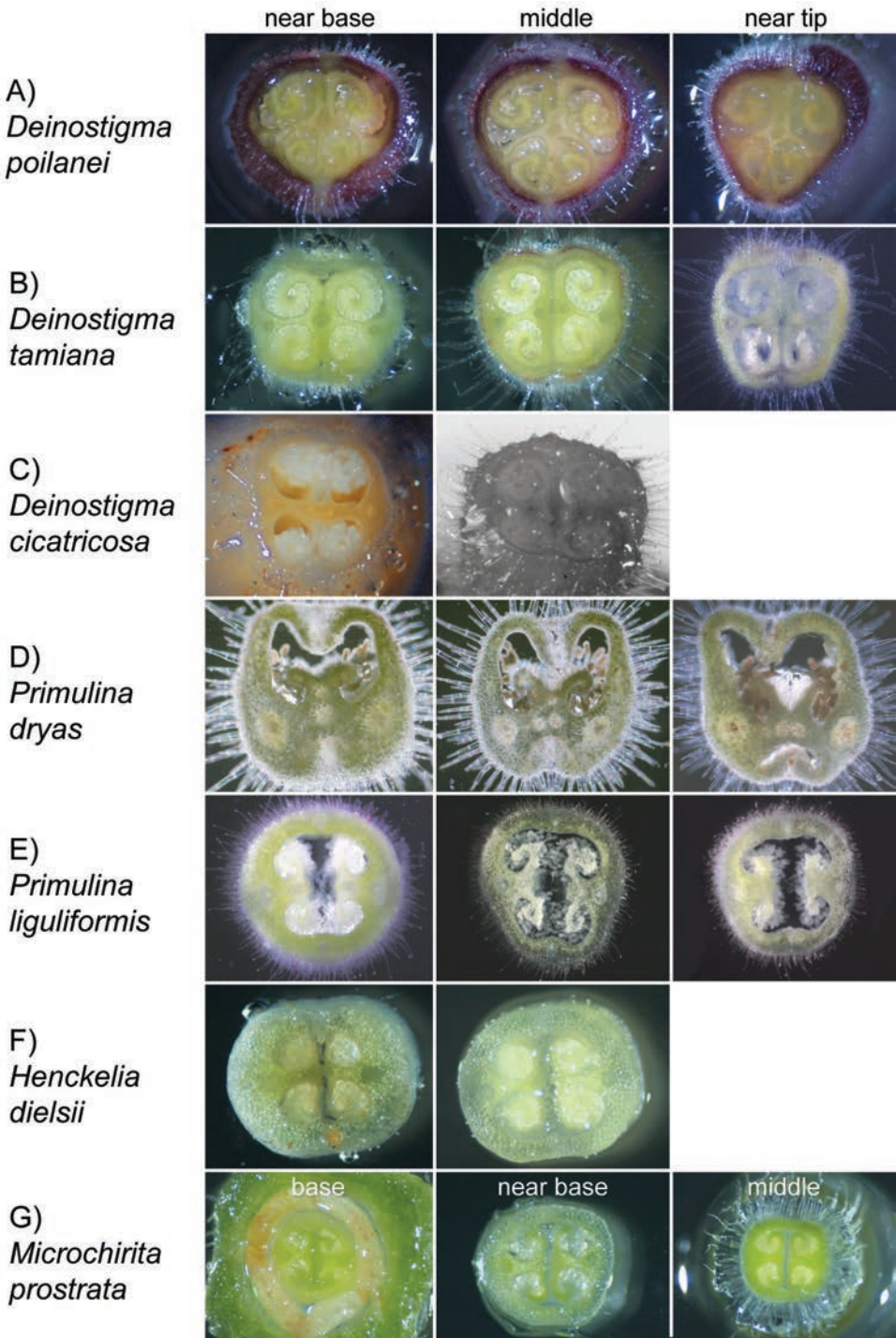


Fig. 3. Photographic sections taken near the base, the middle and the tip of ovaries of diverse species belonging to *Deinostigma* W.T.Wang & Z.Y.Li (A–C), species previously included in *Chirita* Buch.-Ham. (D–F) and *Microchirita prostrata* J.M.Li & Z.Xia (G). (Photos: M. Möller)

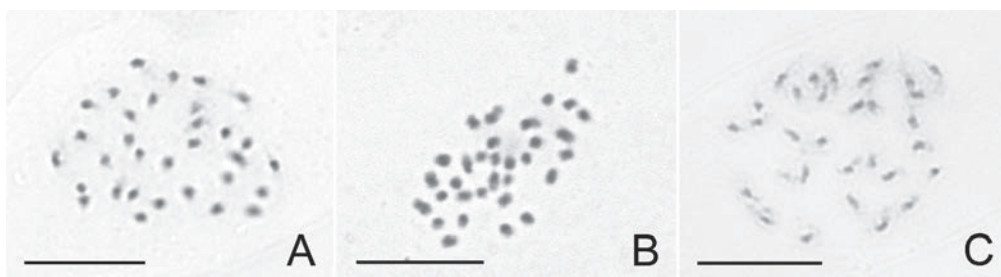


Fig. 4. Chromosome spread preparations of three *Deinostigma* W.T.Wang & Z.Y.Li species. **A.** *Deinostigma poilanei* (Pellegr.) W.T.Wang & Z.Y.Li prometaphase with $2n=32$ chromosomes. **B.** *Deinostigma cicatricosa* (W.T.Wang) D.J.Middleton & Mich.Möller metaphase with $2n = 32$ chromosomes. **C.** *Deinostigma cyrtocarpa* (D.Fang & L.Zeng) Mich.Möller & H.J.Atkins prometaphase with $2n = c. 30$ chromosomes. Scale bar: $10\mu\text{m}$. (Photos: A, C: M. Möller; B: Hui-Min Li)

Geography

The Annamite range of mountains that straddles the border between Vietnam and Laos, and extends into NE Cambodia and further south in Vietnam to just north of Ho Chi Minh City, is known to be an area of high biodiversity and home to many endemic species of plants and animals (Averyanov et al., 2003; WWF, 2015). The Annamites are particularly interesting for Gesneriaceae as the genus *Billolivia* D.J.Middleton, now with seven species (all of which were also described as new), was recently described from the southern end of this range (Middleton et al., 2014a, 2014b; Vu et al., 2015). *Deinostigma*, however, occurs across almost the full length of the mountain range and into southern China, a distribution pattern not otherwise observed in other Gesneriaceae genera except for those which are generally much more widespread (e.g. *Aeschynanthus* Jack, *Didymocarpus* Wall., *Rhynchotechum* Blume).

Conclusion

In summary, phylogeny, cytology and morphology support a separation of *Chirita cicatricosa* (previously included in synonymy of *Primulina minutihamata*), *Primulina cyrtocarpa* and *P. tamiana* from *Primulina* and their integration into an expanded genus *Deinostigma* with a distribution range covering Southern China and Vietnam. *Primulina cynostyla*, *P. eberhardtii* and *P. minutihamata* must also be moved into *Deinostigma* based on their close morphological similarities to species which have been included in the phylogeny. The genus includes species with leaves in alternate arrangement with distinct nodes (except congested in *D. cynostyla*), bilocular ovaries, at least at the base, and a chromosome number smaller than $2n = 36$, these characters distinguishing *Deinostigma* from *Primulina* s.s. *Metapetrocosmea*, though monotypic and sister to *Deinostigma* in the phylogeny, is excluded from *Deinostigma* due to its many differences, such as the unilocular ovary, epipetry, free anthers, capitate stigma, and the capsule globose and straight in relation to the pedicel.

Taxonomy

We do not attempt a revision here of the species now included in *Deinostigma* but note that a revision is needed. The only major change to the existing taxonomy that we make is to resurrect *Chirita cicatricosa* from synonymy of *Primulina minutihamata* and make combinations in *Deinostigma* for both (see below). All type material cited below has been seen by the authors.

Deinostigma W.T.Wang & Z.Y.Li, Acta Phytotax. Sin. 30(4): 356 (1992). – TYPE: *Deinostigma poilanei* (Pellegr.) W.T.Wang & Z.Y.Li

Chirita subsect. *Cicatricosae* W.T.Wang, Bull. Bot. Res., Harbin 1(4): 69 (1981). – TYPE: *Chirita cicatricosa* W.T.Wang

Perennial herbs, caulescent with distinct or short stem. *Leaves* simple, alternate, sometimes congested into a rosette, petiolate; blade slightly peltate or not, margin crenate or dentate, secondary veins pinnate. *Inflorescences* axillary, cymose; pedicels with hooked hairs. *Flowers* with the pedicel inserted at an angle and off-centre on the receptacle. *Calyx* lobes divided to base, elliptic, those on ventral side slightly longer and wider. *Corolla* white, purple, blue or combinations thereof, infundibuliform, lower lip 3-lobed, upper lip 2-lobed, lobe apices rounded. *Fertile stamens* 2, filaments slightly curved, anthers adnate face to face, hairy or with glands, staminodes 3 but with central staminode sometimes obscure. *Nectary* 5-crenate or apparently lacking. *Ovary* fusiform, bilocular throughout or at least near base, then unilocular from middle to apex; stigma of only lower lip developing, broad, flat and weakly 2-lobed. *Fruit* straight to strongly falcate, oblique in relation to the pedicel, dehiscing loculicidally; many-seeded, seeds unappendaged.

Distribution. Seven species in southern China and Vietnam. Some of the Vietnamese material was collected close to the border with Laos and it may also occur in that country.

Deinostigma cicatricosa (W.T.Wang) D.J.Middleton & Mich.Möller, **comb. nov.** – *Chirita cicatricosa* W.T.Wang, Bull. Bot. Res., Harbin 1(4): 69 (1981). – TYPE: China, Guangxi, Dongxing, Banba Commune, Renbei, 3 October 1976, Fang, D. *et al.* 1525 (holotype GXMI [GXMI050619]). (Fig. 5A–D)

Distribution. China (Guangxi).

Notes. Wood (1974) included a specimen from Southern Guangxi (although he cited it as being from ‘Kwangtung’ (Guangdong)) in his new species *Chirita minutihamata*, along with material, including the type, from Vietnam. Wang (1981) later described *Chirita cicatricosa* from Guangxi without explicitly including the Chinese material

of *C. minutihamata* or referring to that species. Wang (1985), Wang et al. (1990) and Wang et al. (1998) placed *Chirita cicatricosa* in synonymy of *C. minutihamata* and cited localities corresponding to the type locality of *C. cicatricosa* and the material cited by Wood (1974). We acknowledge that the material from China and the material from Vietnam are indeed very similar but the differences between them, particularly in the longer, slender, more falcate fruits and the somewhat larger flowers of the Chinese material, along with the widely disjunct distribution, lead us to suspect that they may be recognised as distinct species when the group is revised. We therefore provide the combination in anticipation of this.

Deinostigma cynostyla (B.L.Burtt) D.J.Middleton & H.J.Atkins, **comb. nov.** – *Chirita cynostyla* B.L.Burtt, Notes Roy. Bot. Gard. Edinburgh 23: 96 (1960). – *Primulina cynostyla* (B.L.Burtt) Mich.Möller & A.Weber, Taxon 60: 781 (2011). – TYPE: Vietnam, Da Nang, Ba Na, 1000–1500 m, 27 February 1939, *Poilane, E. 29123* (holotype P [P00602510]).

Distribution. Only known from the Ba Na Hills of central Vietnam.

Notes. This species has not been included in molecular phylogenetic analyses but has been transferred to *Deinostigma* based on its morphological similarity to *Deinostigma poilanei*.

Deinostigma cyrtocarpa (D.Fang & L.Zeng) Mich.Möller & H.J.Atkins, **comb. nov.** – *Chirita cyrtocarpa* D.Fang & L.Zeng, Acta Phytotax. Sin. 31(5): 468 (1993). – *Primulina cyrtocarpa* (D.Fang & L.Zeng) Mich.Möller & A.Weber, Taxon 60: 781 (2011). – TYPE: China, Guangxi, Hezhou City, 130–140 m, 16 June 1991, *Zhou L.S. & Zeng L. 1263* (holotype GXMI [GXMI050608]). (Fig. 5E–H)

Distribution. NE Guangxi (Hezhou).

Deinostigma eberhardtii (Pellegr.) D.J.Middleton & H.J.Atkins, **comb. nov.** – *Chirita eberhardtii* Pellegr., Bull. Soc. Bot. France 73: 418 (1926). – *Primulina eberhardtii* (Pellegr.) Mich.Möller & A.Weber, Taxon 60: 782 (2011). – TYPE: Vietnam, Thua Thien-Hue, Baika, *Eberhardt 2466* (lectotype P [P00602512], designated here; isolectotype VNM).

Distribution. Vietnam (Thua Thien-Hue and Da Nang).

Notes. This species has not been included in molecular phylogenetic analyses but has been transferred to *Deinostigma* based on its morphological similarity to *Deinostigma poilanei*.

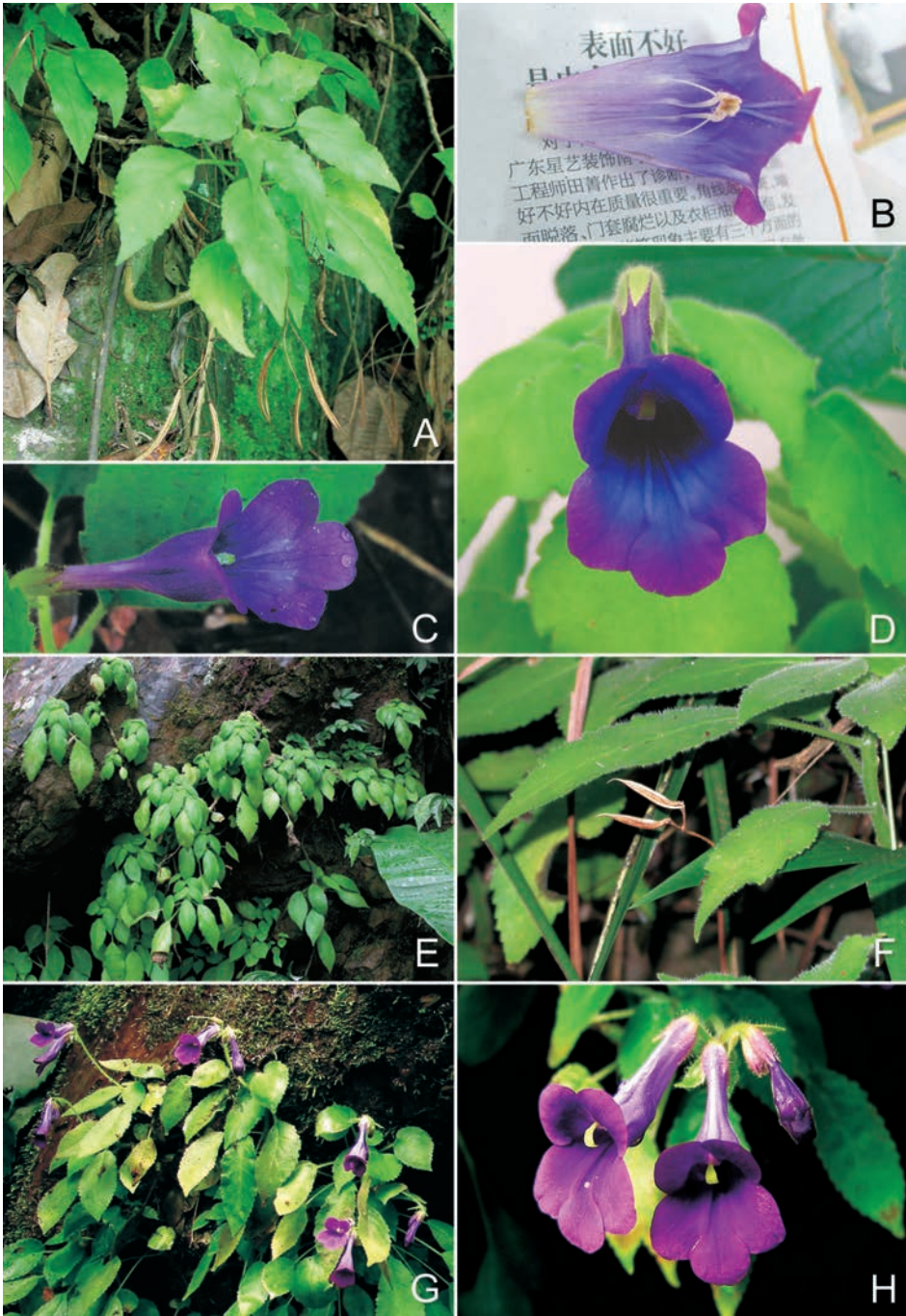


Fig. 5. *Deinostigma cicatricosa* (W.T.Wang) D.J.Middleton & Mich.Möller (A–D) and *D. cyrtocarpa* (D.Fang & L.Zeng) Mich.Möller & H.J.Atkins (E–H). **A.** Habit and mature fruits. **B.** Flower cut open. **C.** Flower top view. **D.** Flower front view. **E.** Habit. **F.** Mature fruits. **G.** Flowering branch. **H.** Flowers front view. (Photos: A, B, E, F: M. Möller; C, D, G, H: Yi-Gang Wei)

Deinostigma minutihamata (D.Wood) D.J.Middleton & H.J.Atkins, **comb. nov.** – *Chirita minutihamata* D.Wood, Notes Roy. Bot. Gard. Edinburgh 31: 370 (1972). – *Primulina minutihamata* (D.Wood) Mich.Möller & A.Weber, Taxon 60: 783 (2011). – TYPE: Vietnam, Kon Tum, Ngok Pa Not, 2300 m, 12 December 1946, *Poilane, E. 35803* (holotype P [P00602518]; isotype P [P00602519]).

Distribution. Vietnam (Kon Tum).

Notes. See notes under *Deinostigma cicatricosa*. This species has not been included in molecular phylogenetic analyses but has been transferred to *Deinostigma* based on its morphological similarity to *D. cicatricosa* and *D. poilanei*.

Deinostigma poilanei (Pellegr.) W.T.Wang & Z.Y.Li, Acta Phytotax. Sin. 30(4): 357 (1992). – *Hemiboea poilanei* Pellegr., Bull. Soc. Bot. France 73: 421 (1926). – TYPE: Vietnam, Khanh Hoa, Nha Trang, 300 m, 29 May 1922, *Poilane, E. 3846* (holotype P [P00606338]; isotype P [P00634330]). (Fig. 6A–E)

Distribution. Vietnam (Khanh Hoa, Thua Thien-Hue and Da Nang).

Deinostigma tamiana (B.L.Burtt) D.J.Middleton & H.J.Atkins, **comb. nov.** – *Chirita tamiana* B.L.Burtt, Gloxinian 49(4): 20 (1999). – *Primulina tamiana* (B.L.Burtt) Mich.Möller & A.Weber, Taxon 60: 785 (2011). – TYPE: Originally collected as Soviet-Vietnam Expedition 0/114 from Vietnam, Vinh Phuc, Tam Dao National Park, cultivated in RBGE under accession number 19981743*A, vouchered for the herbarium as *CULTE 15738* (holotype E [E00269898]). (Fig. 6F–J)

Distribution. Vietnam (Vinh Phuc, Tam Dao NP).

ACKNOWLEDGEMENTS. We are grateful to R. Rybková for providing plant material of *Deinostigma poilanei*; the horticultural staff of the Royal Botanic Garden Edinburgh (RBGE) for the cultivation of research material, particularly S. Barber and A. Ensoll; S. Barber for photographs of *Deinostigma poilanei*; and the Science Technical Services at RBGE for access to laboratory facilities and their support of the molecular and morphological work. We acknowledge financial support from the Percy Sladen Memorial Fund (2006) and the RBGE Foreign Travel fund (2006; 2007), and the Guangxi Natural Science Foundation (2015GXN SFBB139004/2015GXNSFBA139105) for fieldwork, and the Museum Nationale d’Histoire Naturelle for funding DJM’s visit. The research of DJM in Singapore Botanic Gardens is supported by the National Parks Board, Singapore. The Royal Botanic Garden Edinburgh is supported by the Rural and Environment Science and Analytical Services division (RESAS) in the Scottish Government.

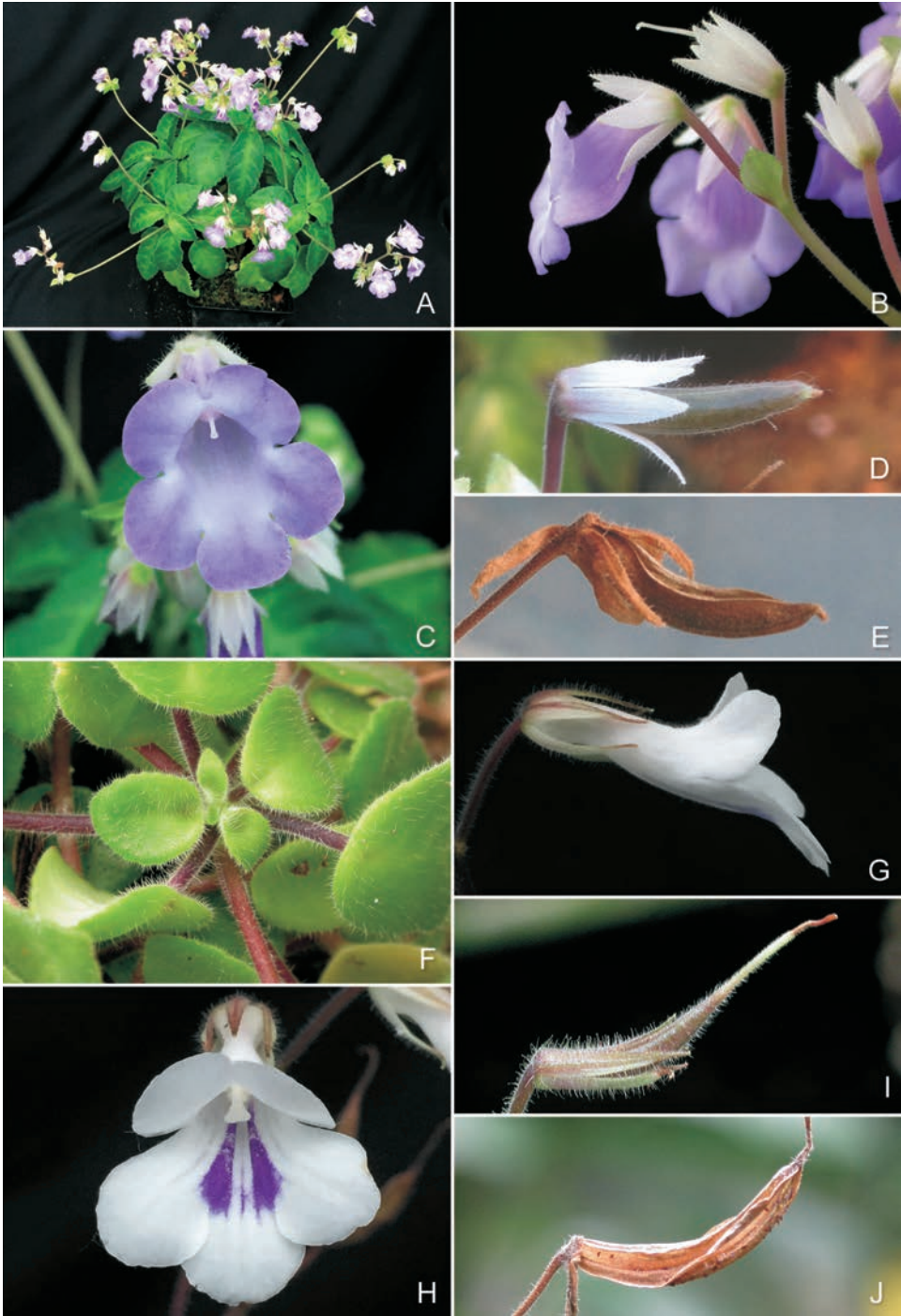


Fig. 6. *Deinostigma poilanei* (Pellegr.) W.T.Wang & Z.Y.Li (A–E) and *D. tamiana* (B.L.Burtt) D.J.Middleton & H.J.Atkins (F–J). **A.** Habit. **B.** Flower side view. **C.** Flower front view. **D.** Immature fruit. **E.** Mature fruit. **F.** Habit. **G.** Flower side view. **H.** Flower front view. **I.** Immature fruit. **J.** Mature fruit. (Photos: A, B, C, F–J: M.Möller; D, E: Sadie Barber)

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Table 1. List of the 132 Gesneriaceae samples of tribe Trichosporae included in the phylogenetic analysis, including voucher number, deposition, origin and GenBank accession numbers for *trnL-F* and ITS respectively.

| Taxon | Voucher number | Deposited in | Origin | <i>trnL-F</i> | ITS or ITS1 / ITS2 |
|--|---|--------------|---|---------------|---------------------|
| <i>Aeschynanthus bracteatus</i> Wall. ex A.DC. | Wang, Y.Z. 991113 | PE | China, Yunnan, Xichou county | FJ501501 | - |
| <i>Aeschynanthus bracteatus</i> Wall. ex A.DC. | Cherry, R. 123 [Cult. RBGE 19970165] | E | Vietnam, Lao Cai | - | AF349203 / AF349284 |
| <i>Aeschynanthus lancilimbus</i> W.T.Wang | Wang, Y.Z. S-10868 | PE | China, unknown locality | FJ501499 | HQ632992 |
| <i>Aeschynanthus micranthus</i> C.B.Clarke | Möller, M. & Qi, Y.D. <i>MMO</i> 01-79 | E, PE, WU | China, Yunnan, Hekou county | FJ501500 | - |
| <i>Aeschynanthus micranthus</i> C.B.Clarke | Reid, A. & Fernie, J. 004 [Cult. RBGE 19951561] | E | China, Yunnan, Xishuangbanna Dai Aut. Pref. | - | AF349218 / AF349299 |
| <i>Aeschynanthus rhododendron</i> Ridl. | Woods, P. 600 [Cult. RBGE 19680624] | E | Malaysia, Genting Highlands | HQ632895 | FJ501333 |
| <i>Aeschynanthus roseoflorus</i> Mendum | Argent, G. 87/14 | E | Indonesia, Seram | HQ632896 | HQ632993 |
| <i>Agalmyla biflora</i> (Elmer) Hilliard & B.L.Burtt | RBGE-PNH/1998 25435 [Cult. RBGE 19980287], | E | Philippines, Palawan, Near summit of Cleopatra Needle | FJ501541 | - |
| <i>Agalmyla biflora</i> (Elmer) Hilliard & B.L.Burtt | RBGE-PNH/1998-25517 [Cult. RBGE 19980292] | E | Philippines, Palawan, near Thumb Peak | - | FJ501361 |
| <i>Agalmyla bilirama</i> Hilliard & B.L.Burtt | RBGE-PNHE 1999 12 | E | Philippines, Leyte Island | HQ632891 | HQ632988 |
| <i>Agalmyla clarkei</i> (Elmer) B.L.Burtt | RBGE-PNH/1999(P99) 13 [Cult. RBGE 19991911] | E | Philippines, Leyte Island, Mt. Lobi | FJ501540 | - |
| <i>Agalmyla clarkei</i> (Elmer) B.L.Burtt | RBGE-PNH/1997 IS26 [Cult. RBGE 19972530A] | E | Philippines, Luzon, Barangay Penicuason | - | FJ501360 |

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|--|---|-----------|---|----------|---------------------|
| <i>Agalmyla glabra</i> (Merr.) Hilliard & B.L.Burt | RBGE-PNHE 1999 28 | E | Philippines, Camiguin Island | HQ632892 | HQ632989 |
| <i>Agalmyla paucipilosa</i> Hilliard & B.L.Burt | Smith & Galloway 261 | E | Indonesia, Sulawesi, Mt. Rantemario | HQ632893 | HQ632990 |
| <i>Agalmyla sojoliana</i> Hilliard & B.L.Burt | Smith & Galloway 321 | E | Indonesia, Sulawesi, Mt. Sojol | HQ632894 | HQ632991 |
| <i>Allocheilos guangxiensis</i> H.Q.Wen, Y.G.Wei & S.H.Zhong | Wei, Y.G. 06-02 | IBK | China, Guangxi, Yongfu county | HQ632897 | HQ632994 |
| <i>Allostigma guangxiense</i> W.T.Wang | Möller, M. & Wei, Y.G. MMO 05-755 | E, IBK | China, Guangxi, Longzhou county | HQ632880 | HQ632977 |
| <i>Anna mollifolia</i> (W.T.Wang) W.T.Wang & K.Y.Pan | Möller, M. & Qi, Y.D. MMO 01-146 | E, PE, WU | China, Guangxi, Napo county | FJ501543 | AF055050 / AF055051 |
| <i>Anna ophiorrhizoides</i> (Hemsl.) B.L.Burt & R.A.Davidson | Möller, M. & Wei, Y.G. MMO 08-1280 | E, IBK | China, Sichuan, Emei Shan | HQ632937 | HQ633034 |
| <i>Anna submontana</i> Pellegr. | Möller, M. & Qi, Y.D. MMO 01-85 | E, PE, WU | China, Yunnan, Maguan county | FJ501542 | FJ501362 |
| <i>Billolivia longipetiolata</i> D.J.Middleton & Luu | Luu Hong Truong & Pham Huu Nhan BD624 | E | Vietnam, Lam Dong Province, Bidoup – Nui Ba National Park | KU985108 | KU985112 |
| <i>Billolivia minutiflora</i> D.J.Middleton & H.Atkins | Ly Ngoc Sam LY498 | E | Vietnam, Lam Dong Province, Da Hoai District | KU985109 | KU985113 |
| <i>Billolivia vietnamensis</i> D.J.Middleton & Luu | Luu Hong Truong & Nguyen Quoc Dat BGM1601 | E | Vietnam, Binh Phuoc, Bu Gia Map National Park | KU985110 | KU985114 |
| <i>Billolivia violacea</i> D.J.Middleton & H.Atkins | Middleton, D.J. 4210 | E | Vietnam, Lam Dong, Duc Trong District | KU985111 | KU985115 |
| <i>Briggsiopsis delavayi</i> (Franch.) K.Y.Pan | Fang, W. 1 | IBK | China, Chongqing, Nanchuan county | HQ632879 | HQ632976 |
| <i>Cathayanthe biflora</i> Chun | Möller, M. & Wei, Y.G. MMO 08-1327 | E, IBK | China, Hainan, Tongshi county | HQ632899 | HQ632996 |

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|--|---|-----|---|----------|------------------------|
| <i>Chayamartitia banksiae</i> D.J.Middleton | <i>Middleton, D.J. 5220 (= Newman, M. et al. LAO1428)</i> | E | Laos, Khammouan, Nakai Nam Theun | KP325433 | KP325426 |
| <i>Chayamartitia smitinandii</i> (B.L.Burt) D.J.Middleton & Mich.Möller | <i>Middleton, D.J. et al. 5632</i> | E | Thailand, Nakhon Nayok, Khao Yai NP | KP325431 | KP325424 |
| <i>Chayamartitia smitinandii</i> (B.L.Burt) D.J.Middleton & Mich.Möller | <i>Middleton, D.J. et al. 5652</i> | E | Thailand, Nakhon Nayok, Khao Yai NP | KP325432 | KP325425 |
| <i>Codonoboea albomarginata</i> (Hemsl.) Kiew | <i>Weber, A. 840805-1/12</i> | WU | Malaysia, Perak, Maxwell's Hill | AJ492297 | HQ632961 |
| <i>Codonoboea codonion</i> (Kiew) C.L.Lim | <i>Lim, C.L. FRI 65040</i> | KEP | Malaysia, Terengganu, Jerangau F.R. | JF912538 | JF912565 |
| <i>Codonoboea corrugata</i> (Mendum) D.J.Middleton | <i>RBGE-PNHE 1998 s.n.</i> | E | Philippines, Palawan | FJ501484 | HQ632962 |
| <i>Codonoboea floribunda</i> (M.R.Hend.) C.L.Lim | <i>Lim, C.L. FRI 64971</i> | KEP | Malaysia, Terengganu, Sg. Nipah F.R. | JF912539 | JF912566 |
| <i>Codonoboea malayana</i> (Hook.f.) Kiew | <i>Kiew, R. & Middleton. D.J. FRI 57513</i> | KEP | Malaysia, Pahang, Fraser's Hill | JF912541 | JF912568 |
| <i>Codonoboea venusta</i> (Ridl.) Kiew | <i>Kiew, R. RK 5430</i> | KEP | Malaysia, Pahang, Fraser's Hill | JF912545 | JF912572 |
| <i>Conandron ramondtioides</i> Siebold & Zucc. | <i>Takeda Herbal Garden Kyoto [Cult. RBGE 19691267]</i> | E | Japan, unknown locality | FJ501515 | FJ501340 |
| <i>Cyrtandra cumingii</i> C.B.Clarke | <i>Kokubugata, G. 11134</i> | TNS | Japan, Ruykyus, Iriomote Island | HQ632905 | HQ633002 |
| <i>Cyrtandra cupulata</i> Ridl. | <i>Weber, A. 840806-2/4</i> | WU | Malaysia, Perak, Maxwell's Hill | FJ501532 | AY818826 / AY818861 |
| <i>Cyrtandra glabra</i> Banks ex C.F.Gaertn. | <i>Cronk, Q.C.B. & Percy, D. T91</i> | E | French Polynesia, Society Is., Tahiti, Mt. Tearoa Col | AY423136 | FJ501353 |

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|--|--|--------|--|----------|-----------|
| <i>Cyrtandra kusaimontana</i> Hosok. | NTBG 960873 | PTBG | Federated States of Micronesia, Caroline Islands | HQ632907 | - |
| <i>Cyrtandra kusaimontana</i> Hosok. | Flynn 5995 | PTBG | Federated States of Micronesia, Caroline Islands | - | EU9119945 |
| <i>Cyrtandra longifolia</i> (Wawra) Hillebr. ex C.B.Clarke | Kiehn, M. 920825-2/1 [Cult. HBV] | WU | USA, Hawaii, Kauai | FJ501531 | EU9119939 |
| <i>Cyrtandra pendula</i> Blume | Weber, A. & <i>Anthonysamy</i> 860730-1/2 [Cult. HBV] | WU | Malaysia, Negeri Sembilan, Kuala Pilah distr., Jeram Toi | FJ501530 | FJ501354 |
| <i>Deinostigma cicatricosa</i> (W.T.Wang) D.J.Middleton & Mich.Möller | Möller, M. & Wei, Y.G. MMO 07-1148 [KN173] | E, IBK | China, Guangxi, Fang Cheng | KU990886 | KU990890 |
| <i>Deinostigma cicatricosa</i> (W.T.Wang) D.J.Middleton & Mich.Möller | Xu, W.-B. s.n. [XWB] | IBK | China, unknown locality | JX506817 | JX506925 |
| <i>Deinostigma cyrtocarpa</i> (D.Fang & L.Zeng) Mich.Möller & H.J.Atkins | Möller, M. & Wei, Y.G. MMO 06-908 | E, IBK | China, Guangxi, He Zhou city | KU990885 | KU990889 |
| <i>Deinostigma poilanei</i> (Pellegr.) W.T.Wang & Z.Y.Li | Rybková, R. HB 222 | E | Vietnam, Hon Ba | KU990888 | KU990892 |
| <i>Deinostigma tamiana</i> (B.L.Burtt) D.J.Middleton & H.J.Atkins | Soviet-Vietnam Expedition (Liberec B.G., Czech Republic & St. Petersburg B.G) 01/114 [Cult. RBGE 19973431/19981743] | E | Vietnam, Vinh Phu | KU990887 | KU990891 |
| <i>Didymocarpus antirrhinoides</i> A.Weber | Jong, K. 9009 [Cult. RBGE 19650167] | E | Malaysia, Perak, Bujong Melaka, Ipoh. | FJ501513 | DQ912671 |
| <i>Didymocarpus citrinus</i> Ridl. | Davis, P. 69437 [Cult. RBGE 19830510] | E | Malaysia, Perlis, Kedah Peak | AJ492293 | DQ912669 |

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|---|---|-----------|--|----------|---------------------|
| <i>Didymocarpus cordatus</i> Wall. ex A.DC. | Weber, A. 860816-2/1 | WU | Malaysia, Perak, Maxwell's Hill | AJ492294 | DQ912673 |
| <i>Didymocarpus podocarpus</i> C.B.Clarke | Noltie, H., Pradhan, Sherub & Wangdi 193 | E | Bhutan, Deothang District | FJ501514 | DQ912688 |
| <i>Didymocarpus stenanthos</i> C.B.Clarke | Möller, M. & Qi, Y.D. <i>MMO 01-156</i> | E, PE, WU | China, Yunnan, Binchuan county | FJ501512 | DQ912687 |
| <i>Didymocarpus villosus</i> D.Don | Adhikari, B. SB 9 | E | Nepal, Sundarjal | HQ632904 | HQ633001 |
| <i>Didymostigma obtusum</i> (C.B.Clarke) W.T.Wang | Möller, M. & Wei, Y.G. <i>MMO 08-1310</i> | E, IBK | China, Guangdong, Fengkai county | HQ632875 | HQ632971 |
| <i>Didymostigma trichanthera</i> C.X.Ye & X.G.Shi | Möller, M. & Wei, Y.G. <i>MMO 08-1335</i> | E, IBK | China, Guangdong, Longmen county | HQ632876 | HQ632972 |
| <i>Glabrella longipes</i> (Hemsl. ex Oliv.) Mich.Möller & W.H.Chen | Möller, M. & Qi, Y.D. <i>MMO 01-122</i> | E, PE, WU | China, Yunnan, Xichou county | FJ501545 | AF055052 / AF055053 |
| <i>Glabrella mihieri</i> (Franch.) Mich.Möller & W.H.Chen | Wang, Y.Z. 11315B | PE | China, Chongqing, Nanchuan county | FJ501544 | FJ501363 |
| <i>Gyrocheilos chorisepalus</i> W.T.Wang var. <i>synsepalus</i> W.T.Wang | Wei, Y.G. 07-708 | IBK | China, Guangdong, Xinyi county | HQ632900 | HQ632997 |
| <i>Gyrocheilos lasiocalyx</i> W.T.Wang | Möller, M. & Wei, Y.G. <i>MMO 06-881</i> | E | China, Guangxi, Guiping county | HQ632901 | HQ632998 |
| <i>Gyrocheilos retrotrichus</i> W.T.Wang | Möller, M. & Wei, Y.G. <i>MMO 07-1136</i> | E, IBK | China, Guangxi, Wuming county | HQ632902 | HQ632999 |
| <i>Gyrocheilos retrotrichus</i> W.T.Wang var. <i>olitgolobus</i> W.T.Wang | Wei, Y.G. 06-208 | IBK | China, Guangxi, Rongshui county, Sirong town | HQ632903 | HQ633000 |
| <i>Hemiboea bicornuta</i> (Hayata) Ohwi | Voucher from Cult. RBGE 19951207 | E | unknown origin | FJ501534 | FJ501356 |
| <i>Hemiboea cavaleriei</i> H.Lév. | Z.J.Gu, Z.J. G3 | KUN | China, unknown locality | FJ501533 | FJ501355 |
| <i>Hemiboea omeiensis</i> W.T.Wang | Möller, M. <i>MMO 08-1271</i> | E, IBK | China, Sichuan, Emei Shan | HQ632886 | HQ632983 |

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| <i>Hemiboea ovalifolia</i> (W.T.Wang) A. Weber & Mich.Möller | <i>B.M.Nong, B.M. 06-1</i> | IBK | China, Guangxi, Napo county, Nonghua | HQ632883 | HQ632980 |
| <i>Hemiboea purpureotincta</i> (W.T.Wang) A. Weber & Mich.Möller | <i>Möller, M. & Wei, Y.G. MMO 06-813</i> | E, IBK | China, Guangxi, Tian Ling county | HQ632884 | HQ632981 |
| <i>Hemiboea subcapitata</i> C.B.Clarke | <i>Wang, Y.Z. 11306</i> | PE | China, Chongqing, Chengkou county | FJ501535 | FJ501357 |
| <i>Henckelia anachoreta</i> (Hance) D.J.Middleton & Mich.Möller | <i>Middleton, D.J. et al. 4480</i> | E | Thailand, Chiang Mai, Doi Suthep | HQ632870 | HQ632966 |
| <i>Henckelia bifolia</i> (D.Don) A.Dietr. | <i>Bhaskar Adhikari L2B6</i> | E | Nepal, Chyalding, near Sybrubesi | JF912522 | JF912549 |
| <i>Henckelia dielsii</i> (Borza) D.J.Middleton & Mich.Möller | <i>Möller, M. et al. MMO 08- 1211</i> | E, KUN | China, Yunnan, Jingdong county | HQ632871 | HQ632967 |
| <i>Henckelia floccosa</i> (Thwaites) A. Weber & B.L.Burtt | <i>Jang, C.G. s.n. [G 157]</i> | WU | Sri Lanka, unknown locality | FJ501486 | HQ632964 |
| <i>Henckelia grandifolia</i> A.Dietr. | <i>Möller, M. et al. MMO 08- 1222</i> | E, KUN | China, Yunnan, Jingdong county | JF912527 | JF912554 |
| <i>Henckelia incana</i> (Vahl) Spreng. | <i>Vogel, S. SVG s.n.</i> | E | India, Nilghiri mts | HQ632869 | HQ632965 |
| <i>Henckelia pumila</i> (D.Don) A.Dietr. | <i>Gaoligong Shan Expedition 1996 7938 [Cult. RBGE 19962271]</i> | E | China, Yunnan, Nuijiang Lisu Aut. Pref., Fugong county | FJ501491 | FJ501327 |
| <i>Henckelia urticifolia</i> (D.Don) A.Dietr. | <i>EMAK 109 H (Edinburgh- Makalu Expedition 1991)</i> | E | Nepal, Sankhuwasabha distr., Arun valley | FJ501492 | FJ501328 |
| <i>Hexatheca fulva</i> C.B.Clarke | <i>Sang, J. & Geri, C. S99358</i> | E | Malaysia, Sarawak, Bau, Fairy Cave | HQ632873 | HQ632969 |
| <i>Liebigia barbata</i> (Jack) D.J.Middleton | <i>Woods, P. 1071 (C6570)</i> | E | Indonesia, Java, forest above Cibodas Garden | FJ501538 | JF501359 |
| <i>Loxostigma fimbrispalum</i> K.Y.Pan | <i>Wang, Y.Z. 991005</i> | PE | China, Yunnan, Jinping county | FJ501507 | KU985104 |

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| <i>Loxostigma glabrifolium</i> D.Fang & K.Y.Pan | Wei, Y.G. 709 | IBK | China, Guangxi, Napo county | HQ632910 | HQ633006 |
| <i>Loxostigma griffithii</i> (Wight) C.B. Clarke | Kew/Edinburgh Kanchenjunga Expedition (1989) 940 [Cult. RBGE 19892473A] | E | Nepal, Yamphudin | FJ501508 | FJ501338 |
| <i>Loxostigma</i> sp. | Gaoligong Shan Expedition 1996 7668 | E | China, Yunnan | AY423137 | HQ633005 |
| <i>Lysionotus chingii</i> Chun ex W.T.Wang | Wang, Y.Z. S-10669 | PE | China, unknown locality | FJ501498 | FJ501332 |
| <i>Lysionotus forrestii</i> W.W.Sm. | Gaoligong Shan Expedition 1996 7925 [Cult. RBGE 19962269A] | E | China, Yunnan, Nujiang Lisu Aut. Pref., | FJ501495 | AF349152 / AF349233 |
| <i>Lysionotus pauciflorus</i> Maxim. | Möller; M. & Qi, Y.D. MMO 01-101 | E, PE, WU | China, Yunnan, Xichou county, Cheng Jia Po | FJ501497 | FJ501331 |
| <i>Lysionotus petelotii</i> Pellegr. | Möller; M. & Qi, Y.D. MMO 01-100/4 | E, PE | China, Yunnan, road to Xichou | FJ501496 | HQ632974 |
| <i>Metapetrocosmea peltata</i> (Merr. & Chun) W.T.Wang | Wei, Y.G. 07-702 | IBK | China, Hainan, Wuzhi Shan | HQ632872 | HQ632968 |
| <i>Microchirita caliginosa</i> (C.B. Clarke) Yin Z. Wang | ex HB Miinchen-Nymphenburg; M.Kiehn & M.Pfossen 2000-1 [Cult. HBV GS-96-02] | WU | Malaysia, unknown locality | FJ501488 | FJ501325 |
| <i>Microchirita aff. hamosa</i> (R.Br.) Yin Z. Wang | Möller; M. & Wei, Y.G. MMO 05-753 | E, IBK | China, Guangxi, Longzhou county | JF912524 | JF912551 |
| <i>Microchirita lavandulacea</i> (Stapf) Yin Z. Wang | Voucher from Cult. RBGE 20000897 | E | China, unknown locality | FJ501487 | FJ501324 |
| <i>Microchirita sericea</i> (Ridl.) A. Weber & Rafidah | Rafidah, A.R. FRI 64328 | KEP | Malaysia, Kelantan, Gunung Reng | JF912548 | JF912521 |

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|---|---------------------------------------|--------|--|----------|----------|
| <i>Microchirita tubulosa</i> (Craib) A. Weber & D.J. Middleton | Middleton, D.J. et al. 4809 | E | Thailand, Nakhon Sawan, Wat Thep Satha Phon | JF912531 | JF912558 |
| <i>Microchirita viola</i> (Ridl.) A. Weber & Rafidah | Rafidah, A.R. FRI 64388 | KEP | Malaysia, Kedah, P. Langkawi | JF912533 | JF912560 |
| <i>Oreocharis argyreia</i> Chun ex K. Y. Pan | Möller, M. & Wei, Y.G. MMO 07-1131 | E, IBK | China, Guangxi, Wuming county | HQ632919 | HQ633015 |
| <i>Oreocharis begoniifolia</i> (H.W.Li) Mich. Möller & A. Weber | Möller, M. et al. MMO 08- 1221 | E, KUN | China, Yunnan, Jing Dong county | HQ632929 | HQ633025 |
| <i>Oreocharis benthamii</i> C.B. Clarke | Möller, M. et al. MMO 08- 1317 | E, KUN | China, Guangdong, Zhao Qin county | JF697584 | JF697572 |
| <i>Oreocharis cotinifolia</i> (W.T. Wang) Mich. Möller & A. Weber | Chuan, Q.M. 01 | IBK | China, Guangxi, Dayaoshan, Jinxiu county | HQ632914 | HQ633010 |
| <i>Oreocharis craibii</i> Mich. Möller & A. Weber | Möller, M. & Gao, L.M. MMO 07-1072 | E, KUN | China, Sichuan, Pan Zhi Hua county | HQ632921 | HQ633017 |
| <i>Oreocharis dasyantha</i> Chun var. <i>ferruginosa</i> K. Y. Pan | Wei, Y.G. 07-700 | E | China, Hainan, Delong | HQ632918 | HQ633014 |
| <i>Oreocharis longifolia</i> (Craib) Mich. Möller & A. Weber | Möller, M. et al. MMO 08- 1239 | E, KUN | China, Yunnan, Jingdong county | HQ632934 | HQ633030 |
| <i>Oreocharis mileensis</i> (W.T. Wang) Mich. Möller & A. Weber | Shui, Y.M. 65214 | KUN | China, Yunnan, Shilin county | HQ632928 | HQ633024 |
| <i>Oreocharis ronganensis</i> (K. Y. Pan) Mich. Möller & A. Weber | Möller, M. & Wei, Y.G. MMO 06-776 | E, IBK | China, Guangxi, Rong An county | HQ632927 | HQ633023 |
| <i>Oreocharis stewardii</i> (Chun) Mich. Möller & A. Weber | Möller, M. & Wei, Y.G. MMO 06-917 | E, IBK | China, Guangxi, Shanjiang county | HQ632926 | HQ633022 |
| <i>Petrocodon coriaceifolius</i> (Y.G. Wei) Y.G. Wei & Mich. Möller | Möller, M. & Wei, Y.G. MMO 06-913 | E, IBK | China, Guangxi, Yangshuo county | HQ632943 | HQ633040 |
| <i>Petrocodon dealbatus</i> Hance | Xie, Q.J. J-042 (US 422841) | US | China, Guangdong, Lianxian county | FJ501537 | FJ501358 |

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| <i>Petrocodon ferrugineus</i> Y.G. Wei | Möller, M. & Wei, Y.G. MMO 06-784 | E, IBK | China, Guangxi, Xincheng county | HQ632946 | HQ633043 |
| <i>Petrocodon hancei</i> (Hemsl.) A. Weber & Mich. Möller | Möller, M. & Wei, Y.G. MMO 08-1342 | E, IBK | China, Guangxi, He Zhou city | HQ632944 | HQ633041 |
| <i>Petrocodon hechiensis</i> (Y.G. Wei, Yan Liu & F. Wen) Y.G. Wei & Mich. Möller | Möller, M. & Wei, Y.G. MMO 07-1077 | E, IBK | China, Guangxi, Hechi city | HQ632942 | HQ633039 |
| <i>Petrocodon integrifolius</i> (D. Fang & L. Zeng) A. Weber & Mich. Möller | Möller, M. & Wei, Y.G. MMO 06-865 | E, IBK | China, Guangxi, Longzhou county | HQ632940 | HQ633037 |
| <i>Petrocodon scopulorum</i> (Chun) Yin Z. Wang | Fang, W. 2010-02 | IBK | China, Guizhou, Xiuwen county, Maochong village | HQ632947 | HQ633044 |
| <i>Petrocodon viridescens</i> W.H. Chen, Mich. Möller & Y.M. Shui | Shui, Y.M. et al. 82661 | E | China, Yunnan, Maguan county | HQ632939 | HQ633036 |
| <i>Petrocosmea kerrii</i> Craib | Voucher from Cult. RBGE 19715592 | E | unknown origin | FJ501502 | FJ501334 |
| <i>Petrocosmea minor</i> Hemsl. | Sino-Amer. Bot. Expedition, no. 1574 (US 56119) | US | China, Yunnan, Lunan Xian | FJ501504 | KU985106 |
| <i>Petrocosmea nervosa</i> Craib | Smithsonian Institute 78-057 [Cult. RBGE 19933232] | E, US | China, N Yunnan | AJ492299 | FJ501335 |
| <i>Petrocosmea sericea</i> C.Y. Wu ex H.W. Li | Gu, Z.J. 99-1104 | KUN | China, unknown locality | FJ501503 | KU985105 |
| <i>Primulina dryas</i> (Dunn) Mich. Möller & A. Weber | Godfrey, T.C. 369 [Cult. RBGE 19791050] | E | China, Hong Kong | FJ501524 | FJ501348 |
| <i>Primulina fimbrisepala</i> (Hand.- Mazz.) Yin Z. Wang | B. Pan, B. s.n. | IBK | China, Guangxi | JX506785 | JX506893 |
| <i>Primulina gemella</i> (D. Wood) Yin Z. Wang | L. Averyanov, L. 1987 [Cult. RBGE 19941913] | E | Vietnam, Hong Quang Special Region, Cat Hai | FJ501523 | FJ501345 |

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|--|--|--------|---|----------|----------|
| <i>Primulina glandulosa</i> (D.Fang et al.) Yin Z. Wang | <i>J.M.Li, J.M. 054291</i> | PE | China, Guangxi | DQ872804 | DQ872841 |
| <i>Primulina glandulosa</i> (D.Fang et al.) Yin Z.Wang var. <i>yangshuoensis</i> (F.Wen, Q.X.Zhang & Yue Wang) Mich.Möller & A.Weber | <i>Möller, M. & Wei, Y.G. MMO 06-912</i> | E, IBK | China, Guangxi, Yang Shuo county | HQ632948 | HQ633045 |
| <i>Primulina hochiensis</i> (C.C.Huang & X.X.Chen) Mich.Möller & A.Weber | <i>Pan, B. s.n.</i> | IBK | China, Guangxi | JX506795 | JX506903 |
| <i>Primulina liguliformis</i> (W.T.Wang) Mich.Möller & A.Weber | <i>Pan, B. s.n.</i> | IBK | China, Guangxi | JX506804 | JX506912 |
| <i>Primulina linearifolia</i> (W.T.Wang) Yin Z. Wang | <i>Li, J.M. 11121</i> | PE | China, Guangxi | DQ872810 | DQ872834 |
| <i>Primulina longgangensis</i> (W.T.Wang) Yin Z. Wang | <i>A.Takhtajan, A. & Aruzytov, N. 1975 [Cult. RBGE 19941915]</i> | E | Vietnam, unknown locality | AJ492290 | FJ501347 |
| <i>Primulina luochengensis</i> (Yan Liu & W.B.Xu) Mich.Möller & A.Weber | <i>Wei, Y.G. MMO 07-1163</i> | IBK | China, Guangxi, Luocheng county, Xiaochangan town | HQ632949 | HQ633046 |
| <i>Primulina minutimaculata</i> (D.Fang et W.T. Wang) Yin Z. Wang | <i>Li, J.M. 067134</i> | PE | China, Guangxi | DQ872815 | DQ872828 |
| <i>Primulina ophiopogoides</i> (D.Fang et W.T. Wang) Yin Z. Wang | <i>Wang, Y.Z. 067134</i> | PE | China, Guangxi | DQ872814 | DQ872829 |
| <i>Primulina pinnata</i> (W.T.Wang) Yin Z.Wang | <i>Expedition Beijing 896526 (US 294374)</i> | US | China, Guangxi, Rongshui Xian | FJ501526 | FJ501349 |
| <i>Primulina renifolia</i> (D.Fang & D.H.Qin) Yin Z. Wang | <i>Möller, M. & Wei, Y.G. MMO 06-791</i> | E, IBK | China, Guangxi, Duan county | KU985103 | KU985107 |

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|---|--|--------|---|----------|----------|
| <i>Primulina tabacum</i> Hance | Xie, Q.J. & Ye, C.X. s.n. [Cult. RBGE 19951540] | E | China, Guangdong, Lian River | AJ492300 | FJ501352 |
| <i>Primulina wentsaii</i> (D.Fang, et L.Zeng) Yin Z. Wang | Li, J.M. 11630 | PE | China, Guangxi | DQ872812 | DQ872831 |
| <i>Pseudochirita guangxiensis</i> (S.Z.Huang) W.T.Wang | Möller, M. & Wei, Y.G. MMO 06-798 | E, IBK | China, Guangxi, Mashan county | HQ632908 | HQ633003 |
| <i>Pseudochirita guangxiensis</i> (S.Z.Huang) W.T.Wang var. <i>glauca</i> Y.G.Wei & Yan Liu | Möller, M. & Wei, Y.G. MMO 05-751 | E, IBK | China, Guangxi, Jingxi county | HQ632909 | HQ633004 |
| <i>Raphiocarpus sinicus</i> Chun | Möller, M. & Wei, Y.G. MMO 07-1141 | E, IBK | China, Guangxi, Shangsi county | HQ632877 | HQ632973 |
| <i>Ridleyandra petiolata</i> (Ridl.) A. Weber | Mohd.Hairul, M.A. FRI 60092 | KEP | Malaysia, Kedah, Gunung Inas | HQ632935 | HQ633032 |
| <i>Ridleyandra porphyrantha</i> (A. Weber & Kiew) A. Weber | Weber, A. 870420-2/4 | WU | Malaysia, Pahang, side ridge of Gunung Bunga Buah | FJ501520 | HQ633031 |
| <i>Ridleyandra quercifolia</i> (Ridl.) A. Weber | Yao, T.L. FRI 65405 | KEP | Malaysia, Perak, Maxwell's Hill | HQ632936 | HQ633033 |