

Polystichum peishanii (sect. *Haplopolystichum*, Dryopteridaceae): A new fern species from a limestone area in Guizhou, China

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ABSTRACT. *Polystichum peishanii* L.B. Zhang & H.He (sect. *Haplopolystichum*, Dryopteridaceae), from Guizhou Province, China, characterized by large pinnae with acute apices and entire margins, a combination of features not known in other species of *Polystichum* sect. *Haplopolystichum*, is described as new. *Polystichum peishanii* is similar to *P. guangxiense* W.M. Chu & H.G. Zhou, but differs in having the lamina contracted toward the base, the pinnae apically acute, chartaceous and much larger, and larger scales on the stipe. *Polystichum peishanii* also resembles *P. deltodon* (Baker) Diels, but is distinguishable by its oblong-triangular and much larger pinnae with entire margins. *Polystichum peishanii* is currently known from only three localities in southern Guizhou Province, near the border with Guangxi, China.

Keywords: China; Dryopteridaceae; Guizhou; Limestone flora; New species; *Polystichum peishanii*; sect. *Haplopolystichum* s.l.

INTRODUCTION

The current circumscription of *Polystichum* Roth (Dryopteridaceae) goes back to Ching's removal of *Cyrtogonellum* Ching (1938) and *Cyrtomidietyum* Ching (1940) from *Polystichum* and allies. *Polystichum*, one of the ten largest genera of ferns (Little and Barrington, 2003), contains about 300 species (Barrington, 1995; Kung et al., 2001) or slightly more than 225 species (Fraser-Jenkins, 1991). This genus is nearly cosmopolitan, but the species are most numerous in subtropical regions, with the highest diversity clearly in Asia, especially in southwestern China and adjacent regions (Kung et al., 2001). Flora Reipublicae Popularis Sinicae vol. 5(2) documents 168 species for China (Kung et al., 2001), with new species constantly being described (e.g. Jiang et al., 2000; Wang and Wang, 2001, 2003; Zhang and He, 2009).

Polystichum was determined to be paraphyletic in relation to *Cyrtomidietyum* Ching, *Cyrtogonellum* Ching, and *Cyrtomium* C. Presl subser. *Balansana* Ching & Shing (Little and Barrington, 2003; Li et al., 2004, 2008; Driscoll and Barrington, 2007; Lu et al., 2007). The species of *Polystichum* sects. *Crucifilix* Tagawa, *Haplopolystichum* Tagawa, *Mastigopteris* Tagawa, *Micropolystichum* Daigobo, and *Sphaenopolystichum*

Ching ex W. M. Chu & Z. R. He (which we refer to as *Polystichum* sect. *Haplopolystichum* sensu lato [s.l.]), together with *Cyrtogonellum*, *Cyrtomidietyum*, and *Cyrtomium* subser. *Balansana*, form a strongly supported monophyletic clade based on chloroplast *rbcL*, *rps4-trnS*, and *trnL-F* sequences (BCPC clade; Lu et al., 2007; CCPC clade, Li et al., 2008). Based on morphology, these relationships seem strange, but the synapomorphy of the once-pinnate lamina or its modifications unites the species of *Polystichum* sect. *Haplopolystichum* s.l. The detailed relationships among the species of sect. *Haplopolystichum* s.l. and among sect. *Haplopolystichum* s.l., *Cyrtogonellum*, *Cyrtomidietyum*, and *Cyrtomium* subser. *Balansana* have not yet been resolved and only about one-fifth of the species were sampled in previous molecular studies (Little and Barrington, 2003; Perrie et al., 2003; Li et al., 2004, 2008; Driscoll and Barrington, 2007; Lu et al., 2007).

Polystichum sect. *Haplopolystichum* s.l. contains c. 60 species, of which c. 90% are endemic to the limestone-derived soil in lowland areas of southwestern China (Kung et al., 2001). In this paper, we describe a new species of this group of *Polystichum*, more exactly, of sect. *Haplopolystichum* sensu stricto (s.s.; Daigobo, 1972), found in 2007 in southern Guizhou Province, China.

Although it has been suggested that *Cyrtomidietyum* should be expanded to include the whole monophyletic BCPC (or CCPC) clade containing *Polystichum* sect. *Haplopolystichum* s.l., *Cyrtogonellum*, *Cyrtomidietyum*,

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and *Cyrtomium* subser. *Balansana* (Little and Barrington, 2003), we assign our new species to *Polystichum*. Until the relationships within this clade are well resolved with good sampling, it is premature to revise the nomenclature of *Polystichum* and its allies.

DESCRIPTION

Polystichum peishanii L. B. Zhang & H. He, sp. nov.

—TYPE: CHINA. Guizhou Province: Libo Xian, Weng'ang Township, Dongduo Village, near Guangxi Autonomous Region border, 25°13.12'N, 107°59.26' E, alt. 777 m, broadleaved evergreen forest, stony soil derived from limestone in a ravine, 16 Sep 2007, L. B. Zhang, H. He, B. Xu & Y. Wang 457 (HOLOTYPE: MO; ISOTYPES: CDBI, CTC, MO).

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Figures 1, 2

Species affinis *P. guangxiense* W. M. Chu et H. G. Zhou et *P. deltodonti* (Baker) Diels var. *henryi* Christ; differt a *P. guangxiense* lamina basin versus contracta (in *P. guangxiense* non contracta), pinnis apice acutis (in *P. guangxiense* rotundatis), majoribus (2.4-3.3 × 1.1-1.3 cm; in *P. guangxiense* 1.7-2 × 0.6-0.8 cm), chartaceis (in *P. guangxiense* subcoriaceis), paleis stipitum majoribus (c. 10 × 1.5-1.8 mm; in *P. guangxiense* 5-6 × 1-1.5 mm); a *P. deltodonti* pinnis oblongo-triangularis majoribus (in *P. deltodonti* 0.8-2 × 0.4-1 cm), margine integris non spinosis.

Plants perennial, evergreen, 36-75 cm tall. *Rhizome* erect; scales lanceolate, dark brown. *Fronde* cespitose; petiole 14-32 cm long, 1.5-2 mm in diam. at middle, adaxially canaliculate, yellowish green; basal petiole scales broadly lanceolate, c. 10 × 1.5-1.8 mm, chartaceous, brown, margin obtusely toothed, apex acuminate, matte; distal petiole scales similar but narrower and shorter toward apex of stipe and base of rachis, differing in size, narrowly lanceolate to subulate, chartaceous, dark brown, margin shortly and sparsely ciliate, apex caudate or acute, matte. *Lamina* lanceolate, simply pinnate, 22-43 × 4.5-6.5 cm, base slightly contracted, apex caudate, adaxially lustrous green when fresh; rachis c. 1.5 mm in diam., without proliferating buds, adaxially canaliculate, rachis scales subulate, dark brown. *Pinnae* 18-38 pairs, two basal pairs 1.7-2.3 cm apart, alternate, attached at c. 80-degree angle to rachis, 2.4-3.3 × 1.1-1.3 cm, shortly stalked, oblong-triangular, chartaceous, acroscopic base auriculate, basisopic base cuneate, margin entire, apex acute, abaxially scaly, adaxially glabrous; microscales present on abaxial surface, subulate, to 1 cm long; adaxial midrib concave, abaxially raised; lateral veins free, once dichotomous, c. 11 pairs from midrib per pinna, abaxially raised and obvious, adaxially indistinct. *Sori* terminal on veins of upper pinnae, 1-20 per fertile pinna, c. 1 mm distant from pinna margin, yellowish when young, brown when old; *indusia* peltate, c. 1 mm in diam., membranaceous, yellowish brown, margin repand.

Additional specimens examined. CHINA. Guizhou

Province: Pingtang Xian, Tangbian Township, Dadaihe Village, Sinkhole Group, 25°36.46' N, 106°49.04' E, alt. 1,070 m, under broadleaved forest, in limestone crevices, 24 Oct 2008, L. B. Zhang, H. He & C. B. Jiang 778 (CDBI, CTC, MO). Guizhou Province: Libo Xian, Dongtang Township, Banzhai Village, Langgan to Limingguang Pass, 25°12.98' N, 108°01.63' E, alt. 700 m, under broadleaved forest, on limestone wall, 30 Oct 2008, L. B. Zhang, H. He & C. B. Jiang 875 (CDBI, CTC, HGAS, MO).

Distribution. *Polystichum peishanii* is known only from two counties, Libo Xian and Pingtang Xian, in southern Guizhou, China (Figure 3) at around 700-1,070 m. Only c. 50 individuals were found in three localities (two in Libo Xian and one in Pingtang Xian) cited above and the two farthest localities are separated by c. 120 km (air line). The new species is likely to be found in other places in Libo Xian and Pingtang Xian and in the adjacent Guangxi Autonomous Region in China.

Ecology. Broadleaved evergreen forests dominated by *Cyclobalanopsis glauca* mixed with *Celtis sinensis* and *Zelkova serrata* at 700-1,070 m, on basic black soil derived from limestone in ravines. Associated plants include *Asparagus cochinchinensis*, *Carex* sp., *Centella asiatica*, *Cyrtomium grossum* and various seed plants.

Etymology. We name *Polystichum peishanii* in honor of Professor Peishan Wang of the Guizhou Institute of Biology, Guizhou Academy of Sciences, Guiyang, for his long and dedicated study of the fern diversity of Guizhou, China. He is the senior author of the *Pteridophyte Flora of Guizhou*, which documents the 770 species of ferns and lycophytes in the province (Wang and Wang, 2001).

Morphological notes. The discovery of *P. peishanii* in southern Guizhou Province, on the bordering with Guangxi Autonomous Region, is reminiscent of the discovery of *P. guangxiense*, described from Napo, western Guangxi (Zhou et al., 1996), about 310 km southwest of Libo, where *P. peishanii* was discovered. Indeed these two species share more or less oblong pinnae with entire margins and sori located close to the pinna margins. The two species differ in the following ways: *P. peishanii* has the lamina contracted toward the base, chartaceous pinnae, acute apices, and larger scales on base of the stipe. The lamina of *P. guangxiense* is not contracted toward the base, the pinnae are smaller (1.7-2 × 0.6-0.8 cm), and nearly coriaceous, with the apex obtuse; the scales at the base of the stipe are also smaller (c. 5-6 × 1-1.5 mm).

Polystichum peishanii also resembles *P. deltodon* var. *deltodon* in that both have the apex of the pinnae acute, but the margins of the pinnae of *P. peishanii* are nearly entire, while the pinna margins of *P. deltodon* var. *deltodon* are toothed. Notably, the margins of the pinnae of *P. deltodon* var. *henryi* are nearly entire. Both *P. deltodon* var. *deltodon* and var. *henryi* have triangular, much smaller pinnae (1.7-2 × 0.6-0.8 cm) with the apex mucronate. Neither *P. deltodon* var. *deltodon* nor var. *henryi* occur in southern Guizhou (Kung et al., 2001; Wang and Wang, 2001).

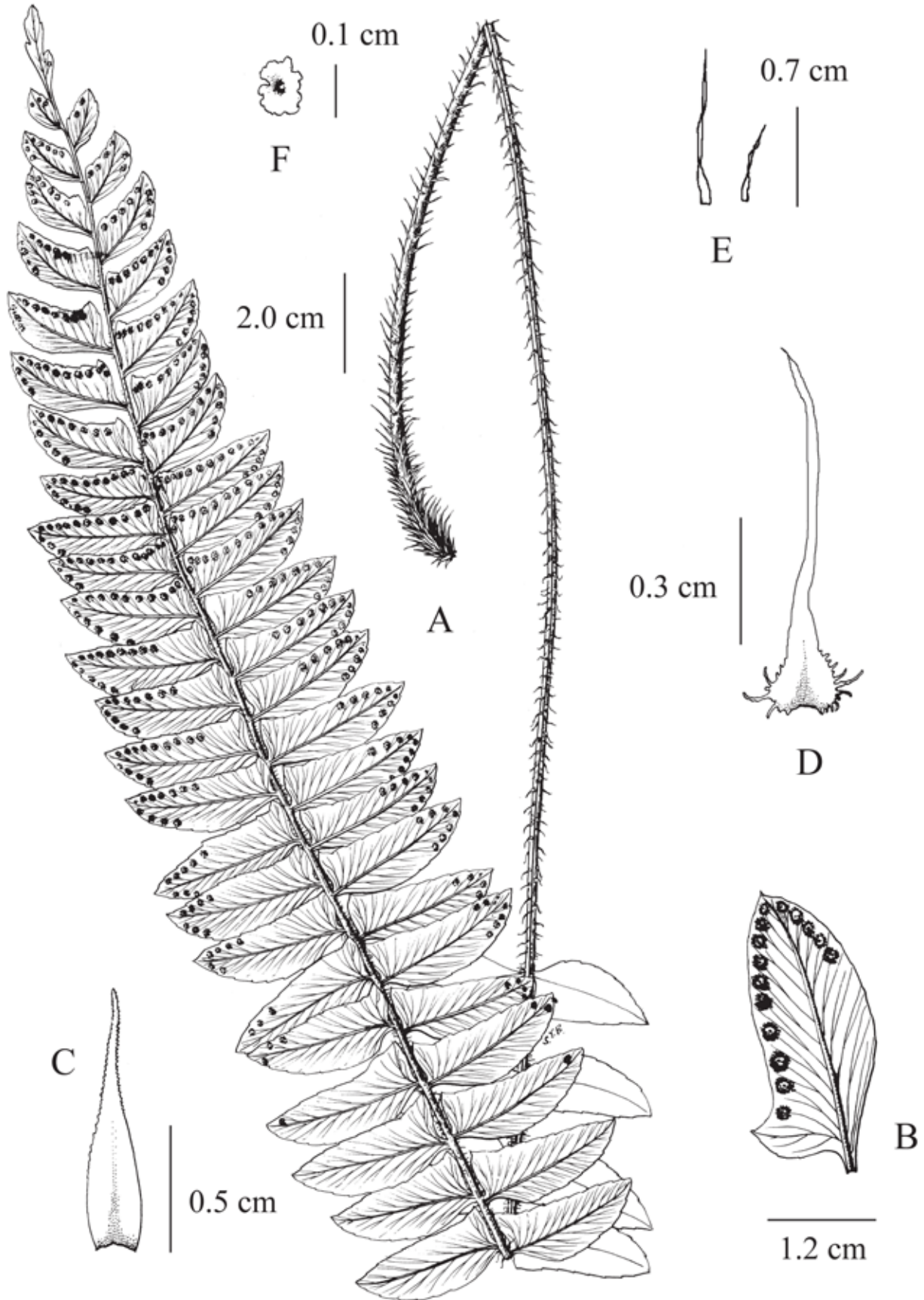


Figure 1. *Polystichum peishanii*. A, Frond; B, Pinna; C, Scale from base of stipe; D, Rachis scale; E, Microscales; F, Indusium (From the holotype, L. B. Zhang, H. He, B. Xu & Y. Wang 457, MO).

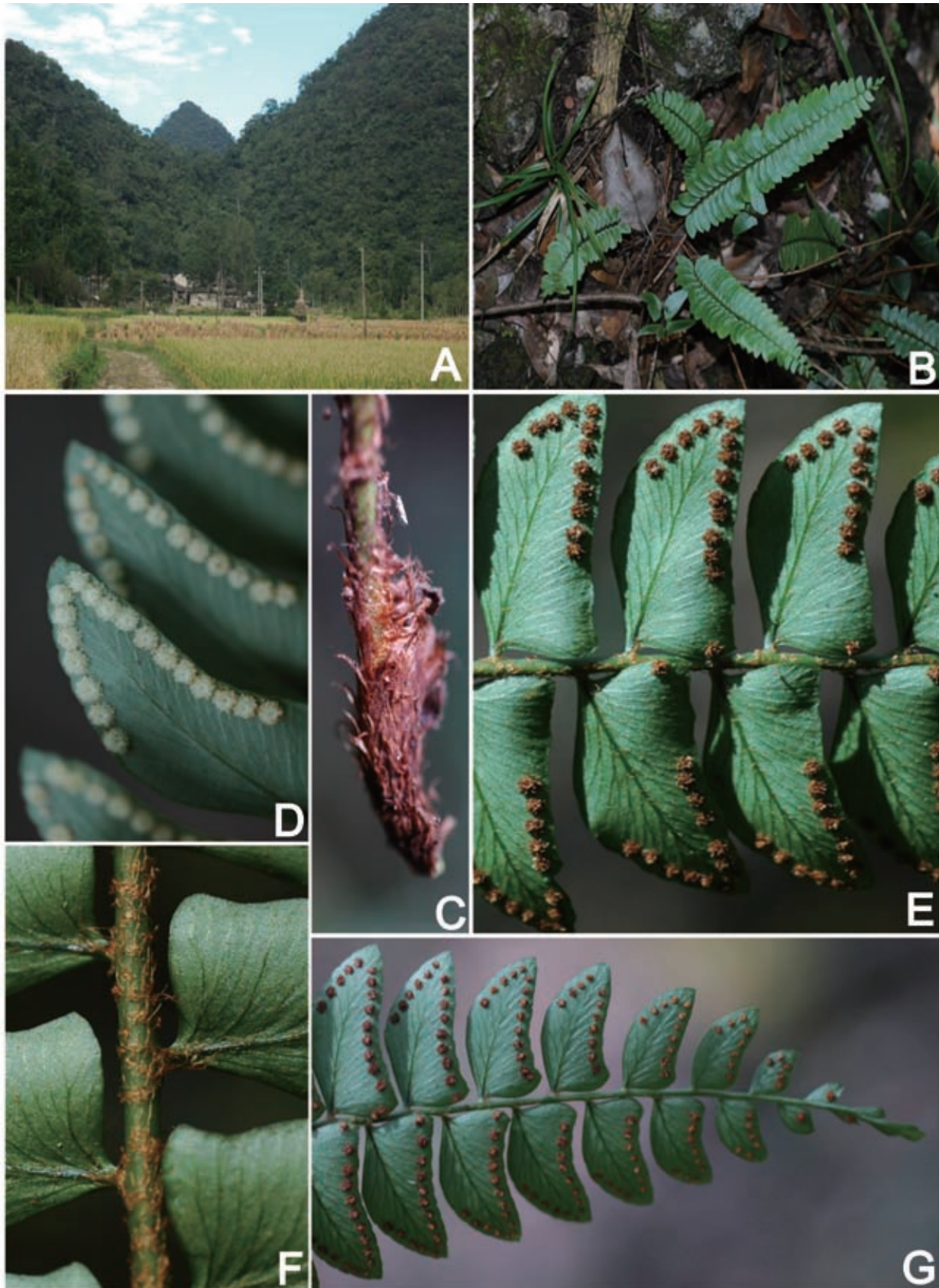


Figure 2. *Polystichum peishanii*. A, Dongduo Village among well preserved evergreen vegetation dominated by *Cyclobalanopsis glauca*, under which the new species was found; B, Habitat, showing slightly contacted lamina base; C, Portion of stipe, showing brown lanceolate scales; D, Portion of lamina, showing current year's yellowish sori; E, Portion of lamina, showing oblong-triangular pinnae with previous year's brown sori; F, Portion of lamina, showing rachis scales; G, Portion of lamina, showing caudate apex.

In *Polystichum* sect. *Haplopolystichum* s.s., there are seven species in China with apically acute pinnae that are attached at nearly right angles to the rachis and mostly not reflexed towards the lamina base. The length to width ratio of the pinnae is ≤ 2 . These seven species are *P. deltodon* (including var. *deltodon*, var. *henryi*, and var. *cultripinum* W. M. Chu & Z. R. He), *P. muscicola* Ching ex W. M. Chu & Z. R. He, *P. nayongense* P. S. Wang & X. Y. Wang, *P. obliquum* (D. Don) T. Moore, *P. paradeltodon* L. L. Xiang, *P. rupicola* Ching ex W. M. Chu, and *P. peishanii*. *Polystichum deltodon* occurs in

eastern, central and southwestern China, Taiwan, Japan, Myanmar, and the Philippines; *P. muscicola* is in western Sichuan and western Hubei; *P. nayongense* is in southern and northern Sichuan, western Guizhou, and southeastern Yunnan; *P. rupicola* is in northwestern Yunnan; *P. obliquum* is in the Sino-Himalayan region from Jammu and Kashmir eastward and in Taiwan, and *P. paradeltodon* is in northwestern Guangxi, western Guizhou, and Yunnan (Kung et al., 2001). These seven species can be distinguished by the following key:

Key to *Polystichum obliquum* and its allies

- 1. Margin of pinnae aristate.
 - 2. Lamina less than 20×1.8 cm; pinnae ovate or ovate-oblong, less than 1×0.6 cm, nearly bilaterally symmetrical *P. muscicola*
 - 2. Lamina more than 25×2 cm; pinnae oblong or shortly falcate, middle pinnae more than 1.5×0.7 cm, obviously bilaterally asymmetrical.
 - 3. Pinnae oblong, apex mostly round or acute..... *P. rupicola*
 - 3. Pinnae falcate, falcate-oblong, oblong or rarely nearly triangular, apex often acute.
 - 4. Acroscopic margin of pinnae below middle of lamina repand or crenulate..... *P. deltodon* var. *cultripinum*
 - 4. Acroscopic margin of pinnae serrate or biserrate.
 - 5. Margin of pinnae regularly serrate and obviously aristate-spinose *P. nayongense*
 - 5. Margin of pinnae irregularly serrate or biserrate and shortly spinose *P. deltodon* var. *deltodon*
- 1. Margin of pinnae not aristate; or if so, pinnae rhombic-ovate.
 - 6. Margin of pinnae entire; pinnae $2.4-3.3 \times 1.1-1.3$ cm.....*P. peishanii*
 - 6. Margin of pinnae repand or slightly toothed; pinnae less than 2×1 cm.
 - 7. Pinnae ovate, rhombic-ovate or rarely oblong, 7-15 pairs; sori between midrib and margin of pinnae ...*P. obliquum*
 - 7. Pinnae oblong or falcate-oblong, 16-40 pairs; sori between midrib and margin or close to margin of pinnae.
 - 8. Sori close to margin of pinnae; pinnae up to 40 pairs.....*P. deltodon* var. *henryi*
 - 8. Sori between midrib and margin or slightly closer to margin of pinnae; pinnae fewer than 20 pairs*P. paradeltodon*

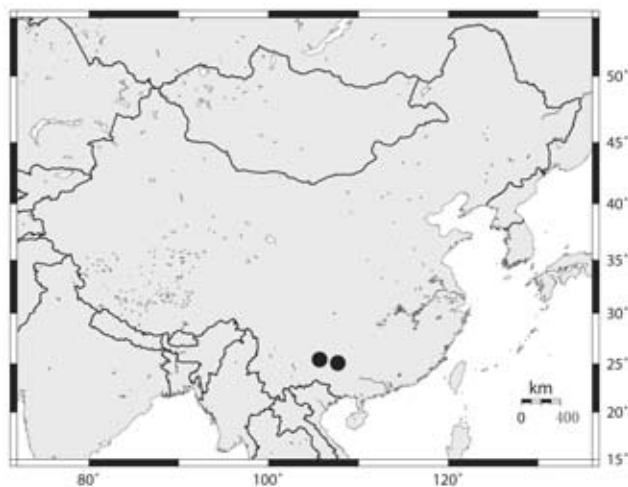


Figure 3. Geographical distribution of *Polystichum peishanii* (●) in southern Guizhou Province, China.

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中國貴州石灰岩地區耳蕨屬半開羽耳蕨組一新種：培善耳蕨

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本文描述了貴州石灰岩地區耳蕨屬半開羽耳蕨組 (*Polystichum* sect. *Haplopolystichum*) 一新種：培善耳蕨 (*P. peishanii*)，並提供線繪圖與彩色照片以資辨識。培善耳蕨的羽片寬大，頂端急尖，邊緣全緣。這些特徵的組合使得它明顯區別於半開羽耳蕨組的其他種類。培善耳蕨與廣西耳蕨 (*P. guangxiense*) 相似，但前者葉片向基部縮短，羽片寬大，草質，頂端急尖，葉柄鱗片寬大，可資區別。培善耳蕨也與對生耳蕨 (*P. deltodon*) 相似，但前者的羽片矩圓狀三角形，寬大，邊緣全緣。培善耳蕨僅見於貴州南部與廣西交界的石灰岩地區。

關鍵詞： 中國；鱗毛蕨科；貴州；石灰岩植物；新種；培善耳蕨；半開羽耳蕨組。