

---

# *Polystichum oblanceolatum*, a New Species in Section *Haplopolystichum* (Dryopteridaceae) from Guangxi, China

Hai He

College of Life Sciences, Chongqing Normal University, Shapingba, Chongqing 400047, People's Republic of China. hehaicq@gmail.com

Li-Bing Zhang\*

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A., and Chengdu Institute of Biology, Chinese Academy of Sciences, P.O. Box 416, Chengdu, Sichuan 610041, People's Republic of China.

\*Corresponding author: Libing.Zhang@mobot.org

---

**ABSTRACT.** A new fern species, *Polystichum oblanceolatum* H. He & Li Bing Zhang (Dryopteridaceae), is described and illustrated from a karst cave in Guangxi, southern China. As a member of *Polystichum* Roth sect. *Haplopolystichum* Tagawa, *P. oblanceolatum* is morphologically most similar to *P. dielsii* Christ and *P. liui* Ching, but is distinguishable from the latter two by its often oblanceolate lamina with acute apex, its repand or broadly dentate pinnae with non-spinulose toothed distal margins, and the less developed, more or less truncate, but not sharply acute, basal acroscopic auricles of the pinnae. The new taxon appears to be endemic to a single karst cave in Tian'e County in northern Guangxi and is considered to be Critically Endangered (CR), based on IUCN Red List criteria. A key is provided to facilitate the identification of *P. oblanceolatum* and morphologically similar species.

**Key words:** China, Dryopteridaceae, Guangxi, IUCN Red List, *Polystichum*.

Species of *Polystichum* Roth (Dryopteridaceae) are widely distributed in the mountains of subtropical and warm-temperate areas in the Northern Hemisphere. Given different circumscriptions of the genus, the superficial similarity of many taxa, and the many under-explored parts across the distribution area, the genus is estimated to contain (180 to) 225 to 400 species worldwide (Kramer, 1990; Fraser-Jenkins, 1991; Kung et al., 2001; Wang & Wang, 2001; Lu, 2005), with about 250 or more species estimated in Asia (Benniamin et al., 2008). In China, *Polystichum* is the most species-rich fern genus, with most known species being found in southwestern China and adjacent regions (Kung et al., 2001). Since the publication of the Chinese-language *Flora Reipublicae Popularis Sinicae*, which recognized 168 species in *Polystichum* (Kung et al., 2001), more than 13 new

species from southwestern China have been described (cf. Zhang & He, 2012). Our extended fieldwork with respect to the fern flora in Chongqing, Guangxi, Guizhou, Sichuan, and Yunnan in recent years has so far led to the discovery of several new species from limestone areas, most of which are endemic to a single cave or sinkhole (Zhang & He, 2009a, 2009b, 2009c, 2010, 2011, 2012; He & Zhang, 2010, 2011; Zhang et al., 2010). However, the high diversity of *Polystichum* in China, especially in less explored southwestern China, is still far from being well understood.

During fieldwork in 2009, we found a species of *Polystichum* with mostly oblanceolate leaves from a karst cave in Tian'e County, northern Guangxi, China. Herein we describe this as another new cave species of *Polystichum* sect. *Haplopolystichum* Tagawa.

***Polystichum oblanceolatum*** H. He & Li Bing Zhang, sp. nov. TYPE: China. Guangxi: Tian'e Co., Bala (Laopeng) Yaozu Autonomous Township, Madong Village, Zhichang, on weathered crust of limestone rocks at bottom of one of two small caves inside a larger karst cave, 24°48.59'N, 107°03.05'E, ca. 890 m, 13 Nov. 2009, L. B. Zhang & H. He 5179 (holotype, CDBI; isotypes, CDBI, CTC, MO). Figures 1, 2.

Species *Polysticho liui* Ching et *P. dielsii* Christ affinis, sed ab eis lamina foliari oblanceolata apice acuta, pinnis repandis vel late dentatis marginibus distalibus non spinuloso-dentatis atque auriculis basalibus acroscopicis minus evolutis apice subtruncatis distinguitur.

Plants perennial, evergreen, (2.8–)6.5–9.5 cm tall; rhizome erect, ca. 4.3 × 2.7–4.3 mm with bases of remnant old petioles, sparsely scaly; scales lanceolate, ca. 0.7 × 0.1 mm, dark brown, margins entire;

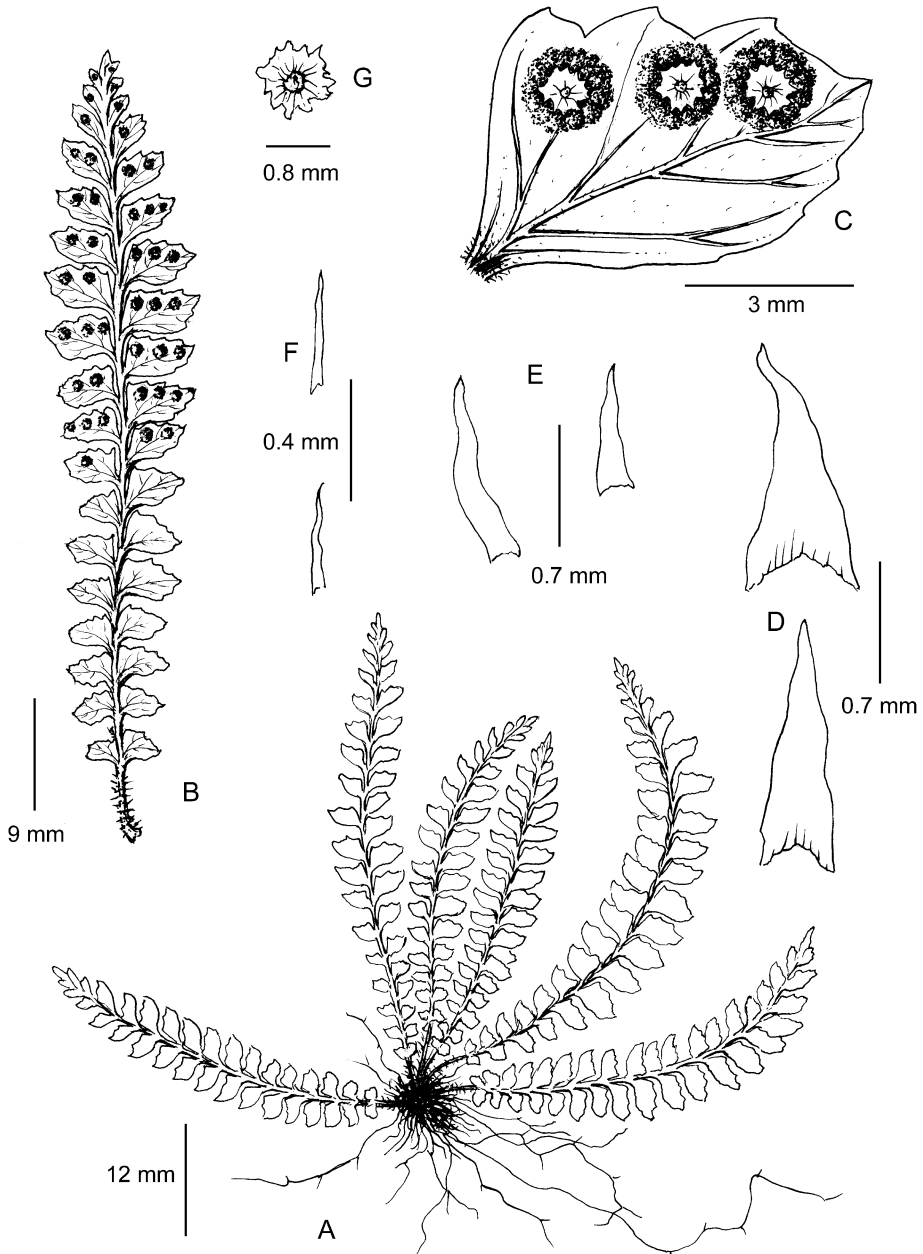


Figure 1. *Polystichum oblanceolatum* H. He & Li Bing Zhang. —A. Habit. —B. Leaf. —C. Pinna. —D. Basal petiole scales. —E. Rachis scales. —F. Pinna microscales. —G. Indusium. Drawings taken from the isotype, *L. B. Zhang & H. He 5179* (CDBI).

roots dull brown when dry, to 11.5 cm, 0.2–0.4 mm diam. Leaves caespitose, 5 to 12 leaves tufted around rhizome, (2.7–)6.3–9.4 cm; petiole stramineous, 0.8–1.4 cm, 0.7–1 mm diam. at middle, adaxially canaliculate, moderately scaly; scales on basal petiole lanceolate to narrowly ovate, chartaceous, 1.4–1.7 × 0.5–0.7 mm, dark brown with narrow,

lighter-colored margins when fresh, but matte brown throughout when dry, margins nearly entire; scales on distal petiole similar, but thinner and narrower, to 1.6 × 0.4 mm, brown; leaf lamina oblanceolate, 1-pinnate, (2.3–)4.5–8.5 × 0.9–1.7 cm, apex acute or shortly acuminate, gradually narrowing in basipetal third; rachis 0.5–0.7 mm diam. at middle, apex

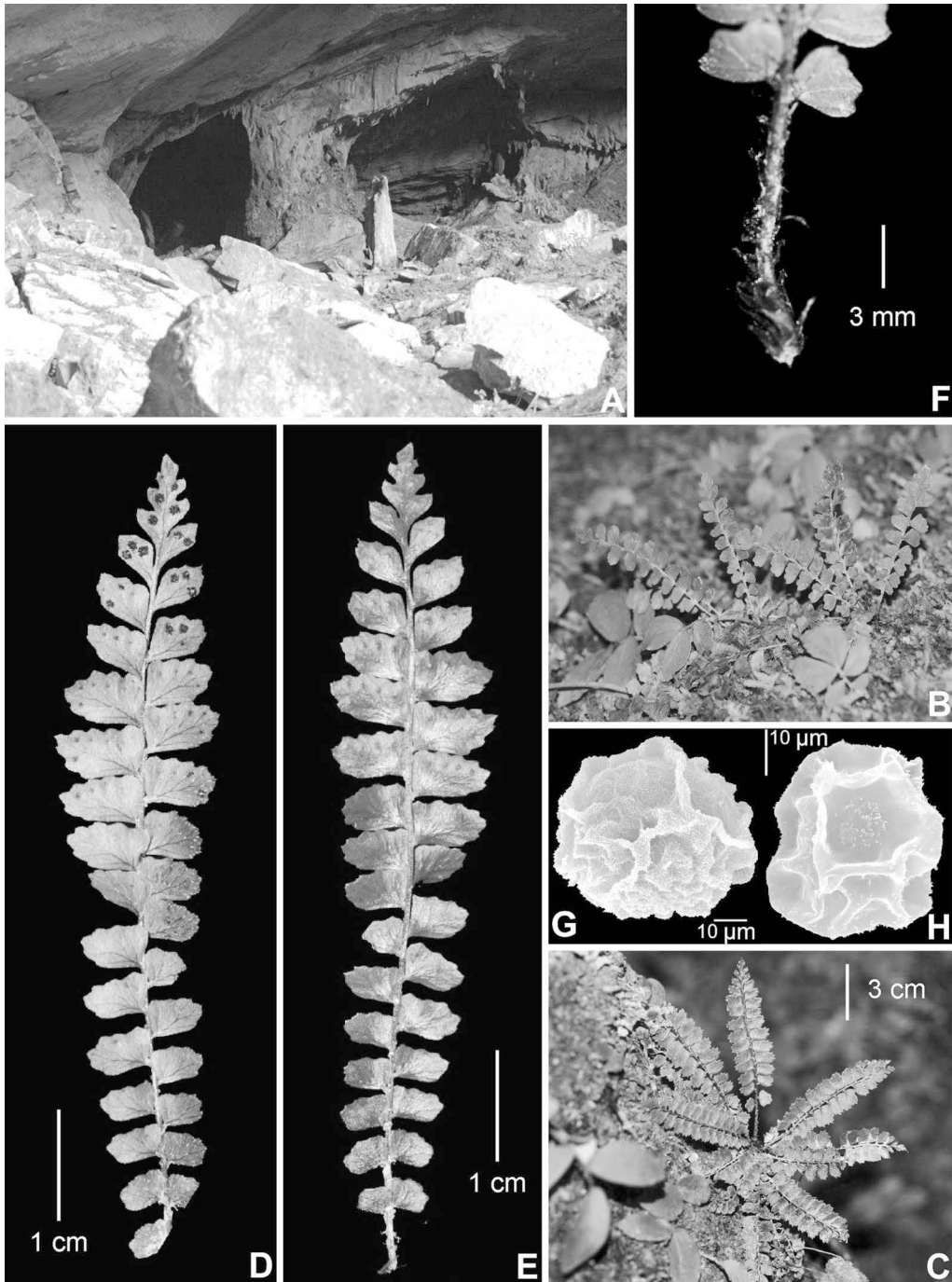


Figure 2. A–G. *Polystichum oblancoelatum* H. He & Li Bing Zhang. —A. Inside view of the karst cave in Tian'e County, northern Guangxi, China, about 15 m from the entrance where *P. oblancoelatum* was discovered. —B. Habit of two individuals accompanied by *Elatostema* J. R. Forst. & G. Forst. —C. Habit of a larger individual. —D. Abaxial view of lamina. —E. Adaxial view of lamina. —F. Basal portion of leaf. —G. SEM micrograph of equatorial view of spore, taken from the isotype, *L. B. Zhang & H. He 5179* (CDBI). —H. *Polystichum dielsii* Christ. SEM micrograph of equatorial view of spore, taken from *L. B. Zhang et al. 751* (MO).

without proliferous bulbils, green, concolorous with pinnae when fresh, stramineous when dry, adaxially sulcate, sparsely scaly abaxially; rachis scales narrowly lanceolate, pale brown, 0.7–1.4 mm, base 0.1–0.3 mm wide, variable in size, but not dilated at base, thinly chartaceous, margins entire, apex subulate; pinnae (5 to)10 to 16 pairs, 4.5–7.8 × 3–4.6 mm, oblong, approximately reaching or slightly imbricate for pinnae in upper middle of lamina, firmly chartaceous, shortly petiolate, petiolules 0.3–0.8 mm, at angles of 70°–90° with rachis, alternate, basal 1 to 3 pinna pairs nearly fan-shaped, bases round to broadly cuneate with acroscopic side being slightly wider, distally repand, with 3 to 5 broad teeth, these occasionally short mucronate; upper pinnae pairs mostly oblong but asymmetric from midribs with acroscopic sides being much broader and slightly auriculate at base, both acroscopic and basiscopic bases nearly truncate, apex acute, distal acroscopic side of pinnae repand or with 3 sinuate teeth, distal basiscopic side mostly with 1 or 2 short broad teeth; adaxial surfaces of pinnae lustrous green when fresh, dull stramineous when dry, glabrous, abaxial surface matte and slightly paler, sparsely covered with scales along veinlets; microscales of pinnae narrowly lanceolate, brown, 0.4–0.6 × 0.01–0.07 mm at base, not dilated at base (narrow-type microscales); venation pinnate, visible abaxially and somewhat obscure adaxially, lateral veins free, single or forked. Sori primarily restricted to distal half of lamina, terminal on lateral veins of pinnae, (1 to)3 to 4(to 6) in 1 row on acroscopic side of pinnae, with only 1 sorus occasionally evident on distal basiscopic side; sori 0.7–1.3 mm diam., 0.6–1.1 mm apart, submarginal, center of sorus 0.3–1.1 mm from pinna margin; indusia peltate, ca. 0.8 mm diam., membranous, pale brown, margins irregularly lacerate; sporangia almost round, ca. 0.3 mm diam., ca. 0.1 mm thick, dark brown when mature; annuli with 11 to 14 thickened cells; stalks ca. 0.3 mm; spores elliptic in equatorial view, perispore sculpture cristate with numerous spinules, 0.3–0.4 μm tall, and perforations ca. 0.13 μm diam.

*Distribution and ecology.* *Polystichum oblanceolatum* is endemic to northern Guangxi, China, and is so far only known from a single cave in karst topography in Tian'e County. The fern was not found in our subsequent expeditions to caves in neighboring counties in 2010. The new taxon was observed among the weathered crust of limestone rocks at the bottom of one of the two smaller caves inside a large one, growing about 15 m from the entrance of the large cave, closely associated with several species of *Elatostema* J. R. Forst. & G. Forst. (Urticaceae) and

unidentified mosses. Other fern and lycophyte species occurring in the same cave included *Asplenium pulcherrimum* (Baker) Ching ex Tardieu, *A. unilaterale* Lam. (Aspleniaceae), *Cyrtomium fortunei* J. Sm., *Polystichum minimum* (Y. T. Hsieh) Li Bing Zhang (Dryopteridaceae), *Pteris deltoidea* Baker, *P. henryi* Christ (Pteridaceae), and an undetermined *Selaginella* P. Beauv. (Selaginellaceae). Seed plants found in the same cave include species of *Ficus* L., *Gynostemma* Blume (Curcubitaceae), *Ophiorrhiza* L. (Rubiaceae), *Pilea* Lindl. (Urticaceae), *Rubus* L. (Rosaceae), and *Tetrastigma* (Miq.) Planch. (Vitaceae).

*IUCN Red List category.* The type population of *Polystichum oblanceolatum* of approximately 37 individuals was scattered across limestone rocks and occupied a total area of about 10 m<sup>2</sup>. According to the IUCN Red List criteria (IUCN, 2008), *P. oblanceolatum* is classified as Critically Endangered (CR). The cave site where this new fern was discovered is just to the side of an intercounty road, and part of the larger cave mouth has been destroyed as a result of the construction of this road. Further expansion of this road may obliterate the habitat of this species.

*Etymology.* The specific epithet *oblanceolatum* is from the Latin, which refers to the overall shape of the leaf lamina of the new species.

*Taxonomic relationships.* Preliminary molecular analysis (Zhang, unpublished) from DNA sequences of the chloroplast *trnL-F* intergenic spacer reveals *Polystichum oblanceolatum* to be closely related to both *P. dielsii* Christ and *P. liui* Ching, but it is morphologically conspecific with neither species. Based on ca. 400 *trnL-F* sequences within the genus, *P. oblanceolatum* shares its *trnL-F* sequence with *P. dielsii* and *P. liui*. *Polystichum oblanceolatum* does share a few morphological similarities with *P. dielsii* and *P. liui* in the generally oblong outline of individual pinnae and its chartaceous and adaxially lustrous green lamina. Both *P. dielsii* and *P. liui* are in the same section *Haplopolystichum* as *P. oblanceolatum*. However, *P. oblanceolatum* differs from *P. dielsii* and *P. liui* morphologically by its general oblanceolate shape of the leaf lamina with acute apex, and its repand or broadly dentate pinnae with toothed distal margins that are not spinulose. The new species typically has fewer than four sori mostly restricted to the acroscopic half of the pinnae. In contrast, both *P. dielsii* and *P. liui* normally have more than six sori per fertile pinna and mostly in two rows on each side of the midrib of the pinnae. The

basal acroscopic auricles of pinnae in *P. oblanco-latum* are typically truncate and not acute as in *P. dielsii* and *P. liui*. Field observations revealed that the basal petiole scales of *P. oblanco-latum*, when fresh, are much darker than those of *P. liui*, but this feature became impossible to discern when the specimens were dried, in which case the scales of both species are dull brown. The distinction between *P. oblanco-latum* and *P. dielsii* is more obvious. The latter taxon is normally much larger in size (with leaves to 50 cm and petioles to 15 cm), with the widest part of the lamina of *P. dielsii* close to the lamina base or much below the middle for lamina that are either elliptic or lanceolate in outline. The basal petiole scales of *P. dielsii* are much thicker in texture and obviously bicolorous with lighter brown, narrow margins, and its pinnae have round apex and spiny margins.

Palynologically, both *Polystichum dielsii* and *P. oblanco-latum* have a cristate perispore sculpture with numerous spinules. In contrast, there are many perforations (ca. 0.13 µm diam.) on the perispore of *P. oblanco-latum* (Fig. 2G), while there are none on that of *P. dielsii* (Fig. 2H). Additionally, there are more spinules on the perispore of *P. oblanco-latum* and they are 0.3–0.4 µm tall. The spinules on the perispore of *P. dielsii* are 0.5–0.7 µm tall. The perispore sculpture of *P. liui* is unknown.

Morphologically similar species of *Polystichum oblanco-latum* include *P. cavernicola* Li Bing Zhang & H. He, *P. jinshoshanense* Ching & Z. Y. Liu, *P. lanceolatum* (Baker) Diels, *P. liboense* P. S. Wang & X. Y. Wang, and *P. speluncicola* Li Bing Zhang & H. He, of which *P. cavernicola*, *P. liboense*, and *P. speluncicola* are endemic to Libo County, southern Guizhou. According to our own observations and the literature (Kung et al., 2001; Wang & Wang, 2001, 2003; Zhang & He, 2010, 2011, 2012), these eight species can readily be identified with the following key.

KEY TO *POLYSTICHUM OBLANCO-LATUM* AND MORPHOLOGICALLY SIMILAR SPECIES IN CHINA

- 1a. Pinnae at middle of lamina spinose on distal margins; pinna with the auricles well developed and with a sharply acute tip ..... 2
- 1b. Pinnae at middle of lamina repand or bluntly serrate on distal margins; pinna with the auricles less developed and with a rounded or broadly acute tip ..... 4
- 2a. Pinna apex obtuse or acuminate in outline and with several small spines; basal petiole scales thickly chartaceous, firm, obviously bicolorous; microscales of pinnae without dilated base; plants taller than 15 cm, with leaves to 50 cm; endemic to southern China (Guangxi, Guizhou) and northern Vietnam ..... *P. dielsii*
- 2b. Pinna apex blunt and ending with one spinose tip; basal petiole scales thinly chartaceous, softer, brown or obscurely bicolorous; microscales of pinnae with dilated base; plants normally <15 cm high ..... 3
- 3a. Pinnae imbricate to each other, oblong, spiny teeth on distal margins with tips pointing toward pinna apex; basal pinnae ± deflexed; endemic to Chongqing, Guizhou, and Hunan ..... *P. liui*
- 3b. Pinnae separate from each other, nearly square-shaped, spiny teeth on distal margins with tips pointing outward; basal pinnae mostly attached at a right angle with rachis; endemic to Guizhou, Hubei, Hunan, Jiangxi, and Sichuan ..... *P. lanceolatum*
- 4a. Pinnae thin and chartaceous, with sharp-tipped teeth on distal margins; endemic to Chongqing, Guizhou, Sichuan, and Yunnan .... *P. jinshoshanense*
- 4b. Pinnae coriaceous or nearly so, repand or with blunt-tipped teeth on distal margins ..... 5
- 5a. Veins obviously tipped with swollen hydathodes; petiole scales ciliate on margin; endemic to southern Guizhou ..... *P. liboense*
- 5b. Veins not swollen at termini; petiole scales nearly entire, irregularly lacerate, or ciliate ..... 6
- 6a. Petiole scales regularly ciliate on margin; microscales broad-type; endemic to southern Guizhou ..... *P. speluncicola*
- 6b. Petiole scales nearly entire, or irregularly lacerate on proximal margins; microscales narrow-type ..... 7
- 7a. Rachis scales dense, subulate, with dilated base, 1.6–3.6 mm; petiole 1–2.5 cm; endemic to southern Guizhou ..... *P. cavernicola*
- 7b. Rachis scales sparse, narrowly lanceolate, without dilated base, 0.7–1.4 mm; petiole 0.8–1.4 cm, endemic to northern Guangxi ..... *P. oblanco-latum*

*Acknowledgments.* This project was supported by the National Natural Science Foundation of China (#31070187) and the Chongqing Municipality Science and Technology Commission (#cstc2011jjA00006) to H.H., and funding from the Open Laboratory of Ecological Restoration and Biodiversity Conservation of Chengdu Institute of Biology, Chinese Academy of Sciences, and a National Geographic Society (U.S.A.) grant to L.-B.Z. We are indebted to Jinyin Xiao for help with fieldwork, Bo Xu with SEM work, Faqiang Lü with the line drawing, and Sara Fuentes, Alexandre Salino, Victoria Hollowell, and Hougao Zhou for helpful comments. Special thanks go to Ning Wu and Xinfen Gao for their support, and the curators of the herbaria CDBI, CTC, and MO for allowing access to the material in their care.

Literature Cited

Benniamin, A., C. R. Fraser-Jenkins & V. Irudayaraj. 2008. *Polystichum manickamianum* (Dryopteridaceae), a new species from South India. *Novon* 18: 287–293.

Fraser-Jenkins, C. R. 1991. An outline monographic study of the genus *Polystichum* in the Indian subcontinent. Pp. 249–287 in T. N. Bhardwaj & C. B. Gena (editors),

- Aspects Pl. Sci., Vol. 13. Today & Tomorrow's Printers & Publishers, New Delhi.
- He, H. & L.-B. Zhang. 2010. *Polystichum kungianum*, sp. nov. (sect. *Mastigopteris*, Dryopteridaceae) from Chongqing, China. Bot. Stud. (Taipei) 51: 395–401.
- He, H. & L.-B. Zhang. 2011. *Polystichum cavernicola*, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from a karst cave in Guizhou, China, and its phylogenetic affinities. Bot. Stud. (Taipei) 52: 121–127.
- IUCN. 2008. IUCN Red List Categories and Criteria, Version 7. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Kramer, K. U. 1990. *Polystichum* Roth. Pp. 114–116 in K. Kubitzki (editor), The Families and Genera of Vascular Plants, Vol. 1. Springer, Berlin.
- Kung, H.-S., W.-M. Chu, Z.-R. He & L.-B. Zhang. 2001. *Polystichum* Roth. Pp. 1–246 in H.-S. Kung (editor), Flora Reipublicae Popularis Sinicae, Vol. 5(2). Science Press, Beijing.
- Lu, S.-G. 2005. *Polystichum* Roth. Pp. 85–147 in C.-Y. Wu (editor), Flora Yunnanica, Vol. 21. Science Press, Beijing.
- Wang, P.-S. & X.-Y. Wang. 2001. *Polystichum* Roth. Pp. 517–552 in Pteridophyte Flora of Guizhou. Guizhou Science & Technology Press, Guiyang.
- Wang, P.-S. & X.-Y. Wang. 2003. Study on pteridophytes of Guizhou (III). Guizhou Sci. 21: 107–110.
- Zhang, L.-B. & H. He. 2009a. *Polystichum weimingii*, sp. nov. (sect. *Metapolystichum*, Dryopteridaceae) from southern Yunnan, China. Syst. Bot. 34: 13–16.
- Zhang, L.-B. & H. He. 2009b. *Polystichum peishanii* (sect. *Haplopolystichum*, Dryopteridaceae): A new fern species from a limestone area in Guizhou, China. Bot. Stud. (Taipei) 50: 101–106.
- Zhang, L.-B. & H. He. 2009c. *Polystichum minutissimum*, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae): The smallest *Polystichum* found in a karst cave in China. Bot. Stud. (Taipei) 50: 353–358.
- Zhang, L.-B. & H. He. 2010. *Polystichum speluncicola*, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) based on morphological, palynological, and molecular evidence with reference to the non-monophyly of *Cyrtogonellum*. Syst. Bot. 35: 13–19.
- Zhang, L.-B. & H. He. 2011. *Polystichum fengshanense*, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from karst caves in Guangxi, China, based on morphological, palynological, and molecular evidence. Syst. Bot. 36: 854–861.
- Zhang, L.-B. & H. He. 2012. *Polystichum perpusillum*, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from a karst cave in China and its isolated phylogenetic relationships. Ann. Bot. Fennici 49: 67–74.
- Zhang, L.-B., H. He & Q. Luo. 2010. *Polystichum puteicola*, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from a karst sinkhole in Guizhou, China, based on molecular, palynological, and morphological evidence. Bot. Stud. (Taipei) 51: 127–136.