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# A New Species of *Bolbitis* (Bolbitidaceae) from Hainan, China

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**ABSTRACT.** During preparation of the account of Bolbitidaceae for the *Flora of China*, it was noticed that specimens of *Bolbitis* Schott, collected from Hainan Island, China, differed from other known species in Bolbitidaceae. This species, *Bolbitis changjiangensis* F. G. Wang & F. W. Xing, is herein described and illustrated as new. Its affinities and differences with the related species are discussed. This new species differs from its congeners by having a short erect rhizome; lateral pinnae in two to four pairs, without spines in the sinuses; and dimorphic fertile leaves. SEM observation of the spores of the new species and *B. subcordata* (Copeland) Ching shows distinct difference in spore morphology.

**Key words:** Bolbitidaceae, *Bolbitis*, China, Hainan, IUCN Red List.

The genus *Bolbitis* was established by Schott (1834–1836) for taxa in *Acrostichum* L. with a creeping rhizome and anastomosing veins. *Bolbitis* had been placed in Dryopteridaceae (Tryon & Tryon, 1982), Dennstaedtiaceae (Holttum, 1954), Lomariopsidaceae (Ching et al., 1964; Hennisman, 1977; Tsai & Shieh, 1994), and Bolbitidaceae (Ching, 1978; Wang, 1999). This is a pantropical genus of ca. 44 known species (Holttum, 1954; Hennisman, 1977; Tryon & Tryon, 1982; Wang, 2006). There are ca. 25 species in China, most distributed in southern and southwestern China (Wang, 1999; Dong & Zhang, 2005).

During the recent survey in Hainan for the Bolbitidaceae for the *Flora of China* treatment, Volume 3, several species of the family were collected and studied, one of which was a large fern forming an extensive population on sandy soil in deep shade near the Nancha River. This appears to be an unrecorded species and is described below.

***Bolbitis changjiangensis*** F. G. Wang & F. W. Xing, sp. nov. TYPE: China. Hainan: Changjiang Co., Bawangling Nat. Reserve, Nancha River, 19°06'N, 109°04'E, 500–600 m, 14 July 2004, F. G. Wang 051 (holotype, IBSC; isotypes, CANT, MO). Figures 1–3.

Species *Bolbitidi subcordatae* (Copeland) Ching similis, sed rhizomatibus erectis, sparse paleaceis; pinnis lateralibus 2- ad 4-jugis, alternis, sinibus pinnarum sine spinis;

pinnis terminalibus longe flagelliformibus, perisporiis dense atque irregulariter cristato-undulatis alis gracilibus differt.

Terrestrial, to 111 cm tall; rhizome short, erect, 2–4 × 0.4–1 cm, with 2 or 3 rows of leaves, sparsely covered with lanceolate, subclathrate, brown or blackish scales; scales lanceolate or spatulate, 4–5 × 2.5–3 mm, dark brown or blackish brown, acuminate, margin sparsely dentate on upper part, subclathrate. Leaves close together, pinnate, thickly chartaceous; sterile leaves pinnate, 70–90 cm; petiole 32–51 cm, stramineous, sparsely scaly or glabrous near base; lamina oblong or ovate-oblong, 36–55 × 24–29 cm, with 2 to 4 pairs of lateral pinnae; lateral pinnae alternate, narrowly oblong-lanceolate, 17–19 × 3.5–4.6 cm, base asymmetric, rounded to truncate, margin usually slightly crenate, without spines in the sinuses, apex long-flagellate; pinnae with 0.1–0.4 cm long petiolule; terminal segment ± conforming to the lateral pinnae, longer than the remaining lamina, somewhat more deeply incised than central pinnae, 25–30 × 2.5–4 cm, apex long-flagellate, usually with a bud below the tip; costae prominent abaxially and adaxially, the lateral veins slightly prominent and with sparse scales; venation pattern with veins forming a costal areole and several to many distal areoles, the veins toward the margin free, excurrent, areoles with one or usually more, or irregular excurrent veinlets; fertile leaves dimorphic; most fertile leaves narrower than sterile leaves, 85–112 cm long, with 2 or 3 pairs of lateral pinnae; lateral pinnae 7–8 × ca. 1.5 cm, obtuse to acuminate, terminal segment 12–13.5 × 1.5–1.8 cm, base asymmetric, rounded to truncate. Sporangia inserted usually all over the abaxial surface, the arrangement acrostichoid, additionally, sporangia inserted on the abaxial surface of contracted pinnae in sterile leaves, the arrangement acrostichoid. Spores monolet, ellipsoid, perispore cristate-undulate, with dense, irregular and thin wing.

**Ecology.** *Bolbitis changjiangensis* is found on sandy soil near the Nancha River in evergreen seasonal rainforest, in humid and shady conditions, and in association with the ferns *Cyclosorus parasiticus* (L.) Farwell, *Neottopteris nidus* (L.) J. Smith, C.

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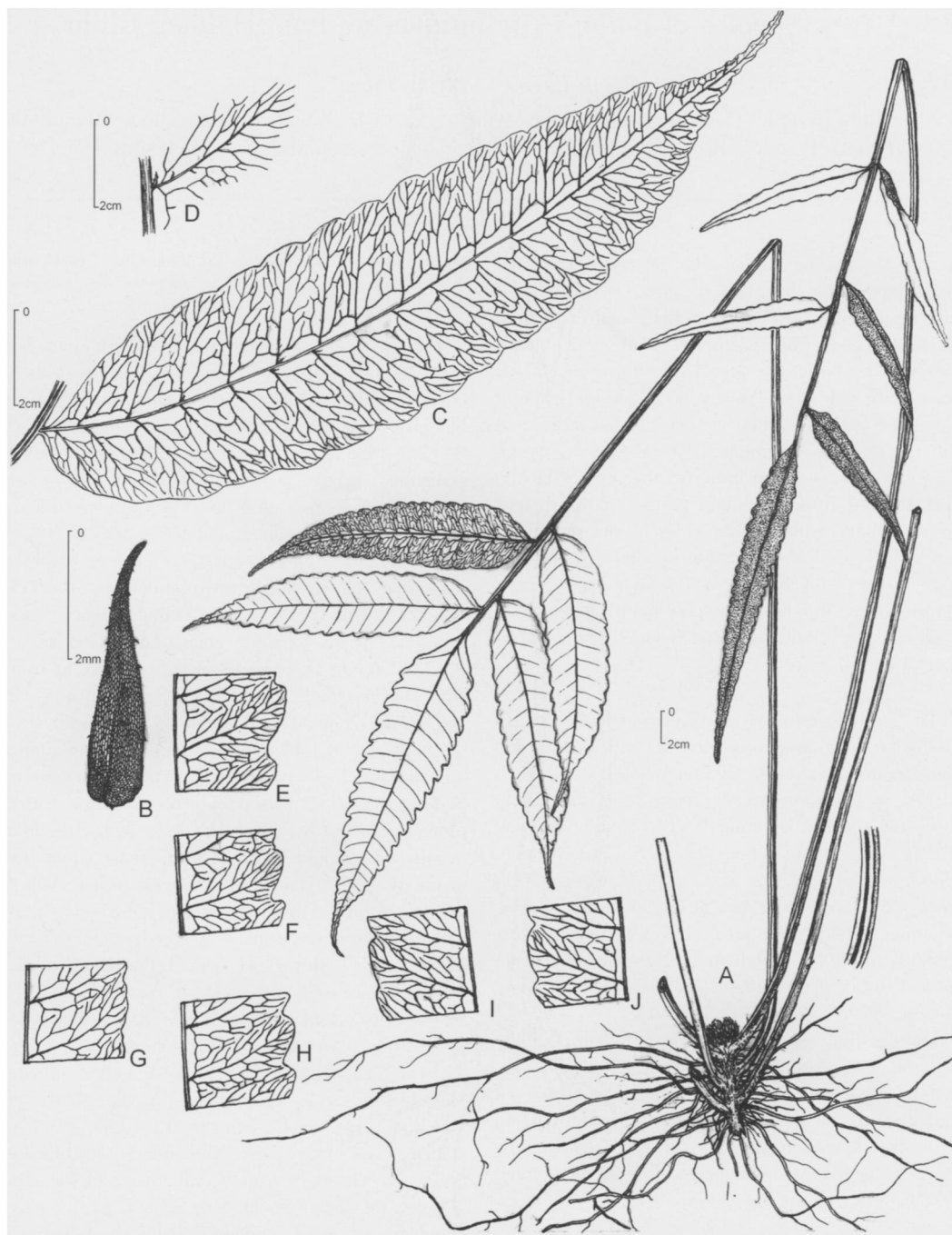


Figure 1. *Bolbitis changjiangensis* F. G. Wang & F. W. Xing. —A. Habit. —B. Enlarged scale. —C. Pinna. —D. Scales along the lateral vein. —E–J. Different patterns of veinlets. Drawn from the holotype F. G. Wang 051 (IBSC) by Yun-xiao Liu.

*latipinnus* (Benth) Tardieu, *Asplenium unilaterale* Lamarck, *Diplazium tomitaroanum* Masamune, *Pseudocyclosorus ciliatus* (Benth) Ching, and *Phymatosorus hainanensis* (Nooteboom) S. G. Lu, and seed plants such as *Ficus hirta* Vahl, *Rubus reflexus* Ker

Gawler, *Ardisia quinqueгона* Blume, *Elaeocarpus sylvestris* (Loureiro) Poir, *Schefflera arboricola* (Hayata) Merrill, *F. auriculata* Loureiro, *Melastoma dodecandrum* Loureiro, and *Dianella ensifolia* (L.) DC.



Figure 2. *Bolbitis changjiangensis* F. G. Wang & F. W. Xing. —A. Habit. —B–D. Fertile pinnae. Drawn from the paratype F. G. Wang 053 (IBSC) by Yun-xiao Liu.

**IUCN Red List category.** *Bolbitis changjiangensis* is known from only one site in Hainan, and the population there is small, consisting of about 100 individuals. As such, it should be considered

Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2001; Hu et al., 2003). Additional biological and breeding studies should be taken toward effective conservation measures.



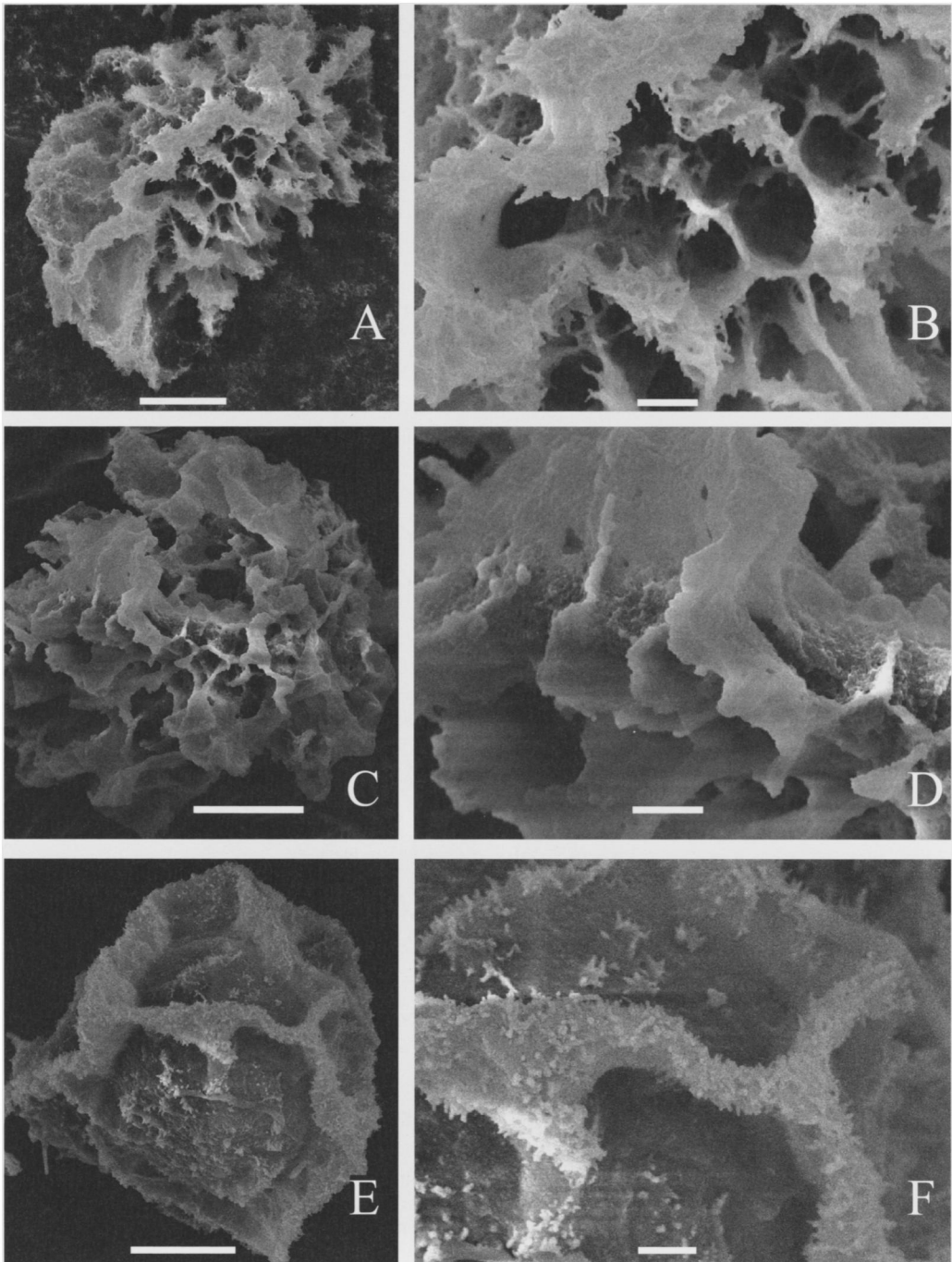


Figure 3. SEM photographs of *Bolbitis* spores. —A, B. *B. changjiangensis* (spore from the holotype *F. G. Wang* 051 [IBSC]: A,  $\times 1600$ , scale bar = 10  $\mu\text{m}$ ; B,  $\times 6000$ , scale bar = 2  $\mu\text{m}$ ). —C, D. *B. changjiangensis* (spore from the paratype *F. G. Wang* 053 [IBSC]: C,  $\times 1900$ , scale bar = 10  $\mu\text{m}$ ; D,  $\times 7000$ , scale bar = 2  $\mu\text{m}$ ). —E, F. *B. subcordata* (spore from *F. G. Wang* 102 [IBSC], Diaoluo Mountain, Hainan, 18 July 2004: E,  $\times 1900$ , scale bar = 10  $\mu\text{m}$ ; F,  $\times 6000$ , scale bar = 2  $\mu\text{m}$ ).

**Relationships.** *Bolbitis changjiangensis* is closely related to *B. subcordata*, with which it shares certain morphological characteristics (Table 1). The spore morphology of *B. subcordata* differs from *B. chang-*

*jiangensis* in that its perispores have fewer, thicker, and regular cristate to undulate wings (Fig. 3). *Bolbitis changjiangensis* is endemic to Bawang Ling, Hainan, whereas *B. subcordata* has a much wider

Table 1. Diagnostic characters of *Bolbitis changjiangensis* and similar species.

Character	<i>B. changjiangensis</i>	<i>B. subcordata</i>	<i>B. heteroclita</i>
Rhizome	short, erect, 2–4 cm tall, 0.4–1 cm thick, sparsely covered with scales	long, creeping, 10–15 mm thick, densely covered with scales	long, creeping, 10–15 mm thick, densely covered with scales
Scales of sterile leaves	sparsely scaly or glabrous near base	densely scaly near base	densely scaly near base
Leaf texture	thickly chartaceous	herbaceous	thinly herbaceous
Lateral pinnae	2 to 4 pairs, alternate; without spines in the sinuses, margin usually slightly crenate, apex long-flagellate	usually 6 to 12 pairs, alternate above, but opposite below the middle; margin with deep undulant lobes, with a prominent tooth in each sinus between the lobes, apex acuminate	1 to 4 pairs, alternate; margin usually $\pm$ entire or sinuate-serrate, rarely with a few setaceous teeth, apex long-flagellate
Terminal pinnae	base rounded to truncate, usually none divided	base truncate, divided	base truncate, none divided
Veinlets of pinnae	areoles forming 1, or usually more, or irregular included veinlets	with or without included veinlets	without included veinlets

distribution, from Japan (southern Kyushu, Ryukyu Island) and China (Fujian, Guangdong, Guangxi, Hainan, Hong Kong, Jiangxi, Taiwan, Yunnan, Zhejiang) to Vietnam (Tonkin, Annam) (Hennipman, 1977; Wang, 1999).

*Bolbitis heteroclita* (Presl) Ching, distributed in southern and southeastern Asian tropics, also resembles *B. changjiangensis* in having fewer pinnae (1 to 4 pairs) but is distinguished from the new species by its long, creeping rhizome and its leaves to 1 cm apart, with margin usually more or less entire or sinuate-serrate, rarely with a few setaceous teeth, with regular veinlets in three rows between lateral veins, and the terminal segment of the lamina generally somewhat to considerably larger.

**Paratype.** CHINA. **Hainan:** Changjiang Co., Bawangling Nat. Reserve, Nancha River, 500–600 m, 14 July 2004, *F. G. Wang* 053 (IBSC).

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