



Isotrema haimingii, a new species of Aristolochiaceae from Dayaoshan Mountain of Guangxi, China

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ABSTRACT: *Isotrema haimingii* Y.S. Huang & Yan Liu, a new species from Dayaoshan Mountain of Guangxi, China, is described and illustrated. It is morphologically most similar to *I. championii* and *I. yachangense* in the shape of leaf blade, lanceolate-ovate bracteoles, oblong anthers, 3-lobed gynostemium and ellipsoid capsules, but can be easily distinguished from them by length of the basal perianth tube, colour of calyx limb and the outside of perianth tube, surface texture of calyx limb and throat. Photos of this new species, as well as a table to distinguish it from other morphologically similar *Isotrema* species, are provided. The threatened status of the new species is also assessed.

KEY WORDS: *Aristolochia*, Dayaoshan Mountain, Flora of Guangxi, *Isotrema championii*, *I. yachangense*, new species, taxonomy.

INTRODUCTION

The genus *Aristolochia* L. (Linnaeus, 1753) sensu lato (s.l.) of Aristolochiaceae comprises about 600 species and widely distributes in tropical, subtropical and temperate regions of the world (González, 2012; Zhu *et al.*, 2019b). Based on molecular phylogeny and morphology, *Isotrema* Raf., previously treated as a subgenus of *Aristolochia* subgen. *Siphisia* (Duch.) Schmidt (Ohi-Toma *et al.*, 2006; Ohi-Toma and Murata, 2016), was reinstated as an independent genus because it has strongly curved calyces, 3-lobed gynostemium with anthers paired on the outer surface of each gynostemium segment, and basipetally dehiscent capsules (Zhu *et al.*, 2019a, b). Although the genus name *Isotrema* is still controversial because many researchers recommend using the name *Aristolochia* rather than *Isotrema* (Do *et al.*, 2019; Peng *et al.*, 2019; Cai *et al.*, 2020; Luo *et al.*, 2020), we will describe this new species using *Isotrema*.

The morphological classification of *Isotrema* is difficult without the characters of flowers. It is true that a significant number of species of *Isotrema* are still incompletely known. Currently, seventy-one species and one subspecies have been recorded in China. As one of the most biodiverse regions of China, Guangxi has 15 species of *Isotrema* (Peng *et al.*, 2019; Zhu *et al.*, 2019a,b; Luo *et al.*, 2020), including *I. bambusifolium* (C.F. Liang ex H.Q. Wen) X.X. Zhu, S. Liao & J.S. Ma, *I. longlinense* (Yan Liu & L. Wu) X.X. Zhu, S. Liao & J.S. Ma, *I. gongchengense* (Y.S. Huang, Y.D. Peng & C.R. Lin) X.X. Zhu, S. Liao & J.S. Ma, which are endemic in this region (Wen, 1992; Qin and Liu, 2010; Huang *et al.*, 2015; Wu *et al.*, 2015).

During fieldwork in Guangxi Dayaoshan National

Nature Reserve in 2016, an interesting species of *Isotrema* attracted our attention, which the upper portion of calyx limb has different stripes with the lower, and the throat has dark purple stripes. We speculated that it might be a new species of *Isotrema*. However, we did not find its fruits. It wasn't until July 2021 that we finally collected its fruiting specimens. After detailed examination of the morphological characters of this unknown species and its morphologically similar species (Merrill and Chun, 1940; Chow and Huang, 1975; Luo *et al.*, 2020), as well as consulting Flora of China (Hwang *et al.*, 2003) and other relevant literature (Cheng *et al.*, 1988; Wen, 1992; Xu *et al.*, 2011; Li *et al.*, 2019; Zhu *et al.*, 2019a,b; Ohi-Toma *et al.*, 2021), we confirmed that this species is new to science, which is described and illustrated below.

MATERIALS AND METHODS

Field surveys have been conducted in flowering and fruiting phases at the type locality. Measurements and assessments of morphological characters were based on wild and cultivated living plants, and specimens gathered from the type locality and herbaria. Type specimens were deposited in herbaria of Guangxi Institute of Botany (IBK) and Guangxi Botanical Garden of Medicinal Plants (GXMG). Comparisons amongst *I. haimingii* Y.S. Huang & Yan Liu, *I. yachangense* (B.G. Huang, Yan Liu & Y.S. Huang) Luu, Q.B. Nguyen & H.C. Nguyen and *I. championii* (Merr. & Chun) X.X. Zhu, S. Liao & J.S. Ma were based on the descriptions of protologues and the specimens (including types) deposited in IBK, GXMG, IBSC, PE, GXMI, KUN, HITBC and K. Photos of herbarium specimens were gathered from JSTOR Global Plants (<http://plants.jstor.org>) and Chinese Virtual

**Table 1.** Morphological comparisons of key characters amongst *Isotrema haimingii*, *I. championii* and *I. yachangense*.

Characters	<i>I. haimingii</i>	<i>I. championii</i>	<i>I. yachangense</i>
Leaf blade	abaxially densely brown villous, lateral veins 8–16 pairs	abaxially densely brown villous, lateral veins 6–15 pairs	villous, abaxially shallowly yellowish-brown pubescent, lateral veins 5–8 pairs
Cyme	on old woody stems or in the axils of leafy shoots	on old woody stems only	on old woody stems only
Pedicel	2.5–4 cm long, densely yellowish-brown villous	3–4 cm long, densely brown villous	1–2 cm long, densely yellowish-brown pubescent
Bracteole	lanceolate-ovate, ca. 5×2 mm, densely yellowish-brown villous	lanceolate-ovate, ca. 10×5 mm, densely yellowish-brown villous	lanceolate-ovate, ca. 4×2 mm, densely yellowish-brown pubescent
Perianth tube	outside yellowish-green, densely yellowish-brown villous; basal portion 4–5 cm long, ca. 1.5 cm wide, longer than the upper; inside dark-purple, densely pubescent near the base	outside mauve, densely villous; basal portion 5–7 cm long, ca. 1.5 cm wide, longer than the upper; inside with mauve stripes, densely pubescent near the base	outside mauve, densely yellowish-brown pubescent; basal portion 2–2.5×0.6–1 cm, shorter than the upper; inside dark-purple, densely villous near the base
Limb	yellowish green, upper portion with dark purple mural-like stripes, lower portion with mauve stripes	mauve, with dark purple reticulate stripes, adaxially papillate	yellow, with dark purple mural-like stripes
Throat	yellowish-green or mauve, with dark purple stripes	yellow, with dark purple spots	yellow, with dark purple spots
Capsule	villous	villous	glabrous

Herbarium (<http://www.cvh.ac.cn/>). Habitat information and threatened factors were obtained during field surveys. The assessment of threatened status of the new species is based on the IUCN Red List of Threatened Species Categories and Criteria, and Guidelines for Using the IUCN Red List Categories and Criteria (IUCN, 2012; IUCN Standards and Petitions Committee, 2022).

TAXONOMIC TREATMENT

Isotrema haimingii Y.S. Huang & Yan Liu, *sp. nov.*

海明關木通 Figs. 1–2, S1A–C & S2

Type: CHINA. Guangxi Zhuang Autonomous Region: Laibin City, Jinxiu Yao Autonomous County, Jinxiu Town, protection station of Silver fir, 1136 m a.s.l., 28 July 2016, *Y.S. Huang & Yan Liu Y3143* (holotype: IBK!; isotypes: IBK!, GXMG!).

Diagnosis: *Isotrema haimingii* Y.S. Huang & Yan Liu is morphologically similar to *I. championii* (Merr. & Chun) X.X. Zhu, S. Liao & J.S. Ma and *I. yachangense* (B.G. Huang, Yan Liu & Y.S. Huang) Luu, Q.B. Nguyen & H.C. Nguyen in the shape of leaf blade, lanceolate-ovate bracteoles, oblong anthers, 3-lobed gynostemium and ellipsoid capsules, but can be distinguished from the former by cyme on old woody stems or in the axils of leafy shoots (vs. on old woody stems only); bracteoles ca. 5 × 2 mm (vs. ca. 10 × 5 mm); perianth tube yellowish-green outside (vs. mauve), basal portion of tube 4–5 cm long (vs. 5–7 cm long); calyx limb yellowish-green, with dark purple mural-like stripes on the upper portion and mauve stripes on the lower portion (vs. purple reticulate stripes, papillate), and from the latter by cyme on old woody stems or in the axils of leafy shoots (vs. on old woody stems only); pedicel 2.5–4 cm long (vs. 1–2 cm long); perianth tube yellowish-green outside (vs. mauve); basal portion of tube 4–5 cm long, longer than the upper (vs. 2–2.5 cm long, shorter than the upper); calyx limb

yellowish-green, with dark purple mural-like stripes on the upper portion and mauve stripes on the lower portion (vs. yellow, with dark purple mural-like stripes), capsules villous (vs. glabrous). The detailed morphological comparisons amongst the three species are summarized in Table 1.

Description: Climbing shrubs. Root spindle-shaped. Stems terete, irregularly striate, densely yellowish-brown villous when young, glabrescent. Leaf blade slightly leathery, lanceolate to elliptic-lanceolate, 12–25 × 3–6 cm, apex narrowly acuminate, base rounded or shallowly cordate, margin entire, adaxially glabrous except villous midvein and lateral veins, abaxially densely yellowish-brown villous; basal veins 3; lateral veins 8–16 pairs, making curved arches meeting up to the margin, adaxially inconspicuous, abaxially prominent; petiole 1–2 cm long, densely yellowish-brown villous. Cymes on old woody stems or in the axils of leafy shoots, solitary or 2–5-flowered; pedicel pendulous, 2.5–4 cm long, densely yellowish-brown villous; bracteoles ca. 5 × 2 mm, densely yellowish-brown villous; perianth tube horseshoe-shaped, outside yellowish-green, densely yellowish-brown villous; basal portion of tube 4–5 cm long, ca. 1.5 cm in diam., inside dark purple near the base, densely pubescent; upper portion of tube 3–3.5 cm long, ca. 1.2 cm in diam., outside yellowish-green, inside glabrous; calyx limb discoid, 4–6 cm in diam., yellowish-green, upper portion with dark purple mural-like stripes, lower portion with mauve stripes, margin shallowly 3-lobed; throat suborbicular, 1.2–1.5 cm in diam., yellowish-green or mauve, with dark purple stripes; stamens 6, filament absent, anthers oblong, 3–5 mm long, ca. 1 mm wide, adnate to the gynostemium base, paired on the outer surface of each gynostemium segment; gynostemium 3-lobed, apex of lobes obtuse, margin glabrous and papillate; ovary terete, ca. 1.5 cm long, 4–5 mm wide, 6-angled, densely yellowish-brown villous.

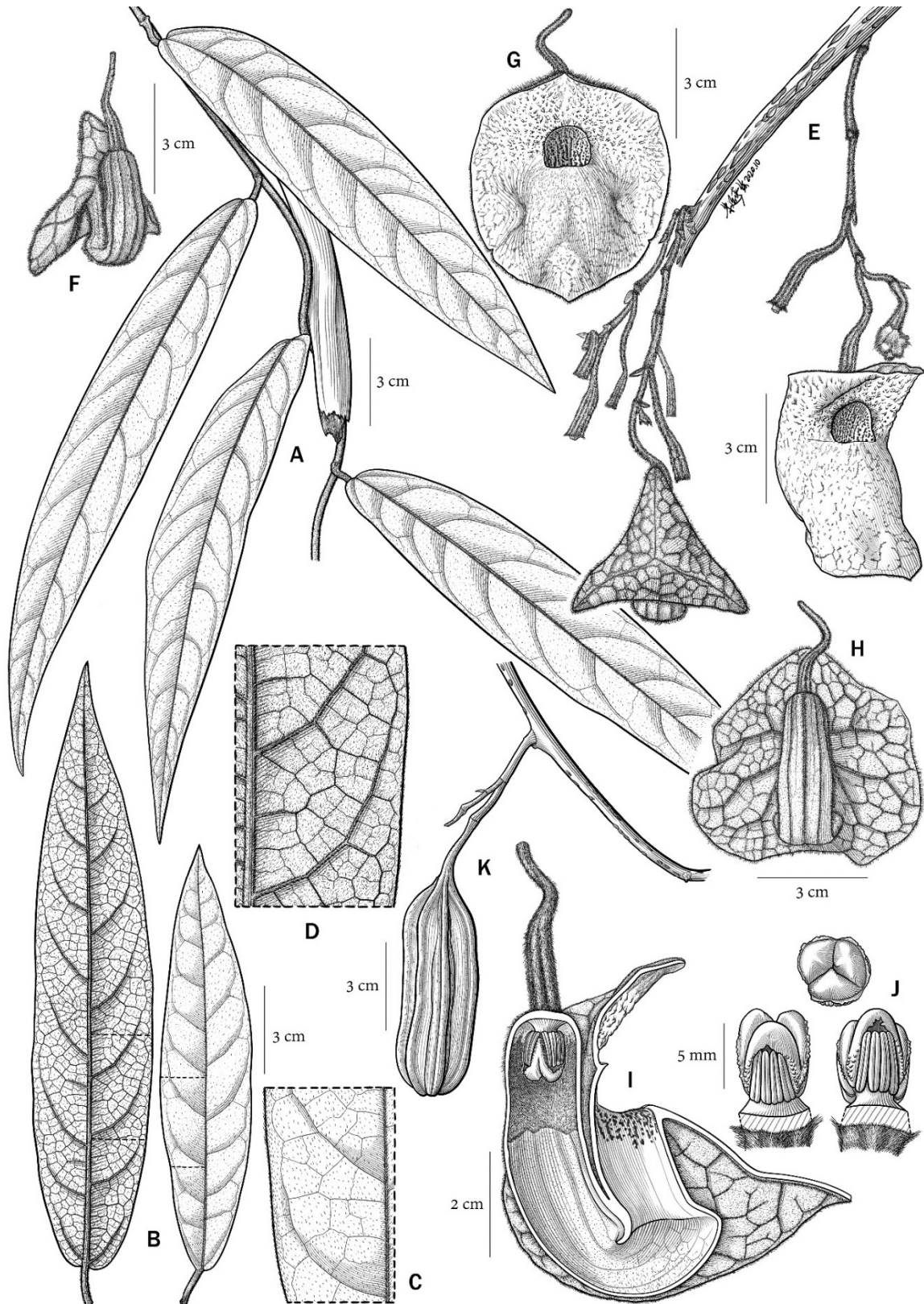


Fig. 1. *Isotrema haimingii* Y.S. Huang & Yan Liu, *sp. nov.* **A:** Habit. **B:** Leaf blades (adaxially and abaxially view). **C:** Portion of adaxially leaf blade (magnified view). **D:** Portion of abaxially leaf blade (magnified view). **E:** Cymes (showing unopened and blooming flowers). **F:** Flower (lateral view). **G:** Flower (front view, showing the calyx limb). **H:** Flower (dorsal view). **I:** Longitudinally dissected flower (showing the inside characters). **J:** Gynostemium and anthers. **K:** Capsule. (Drawn by Yun-Xi Zhu)

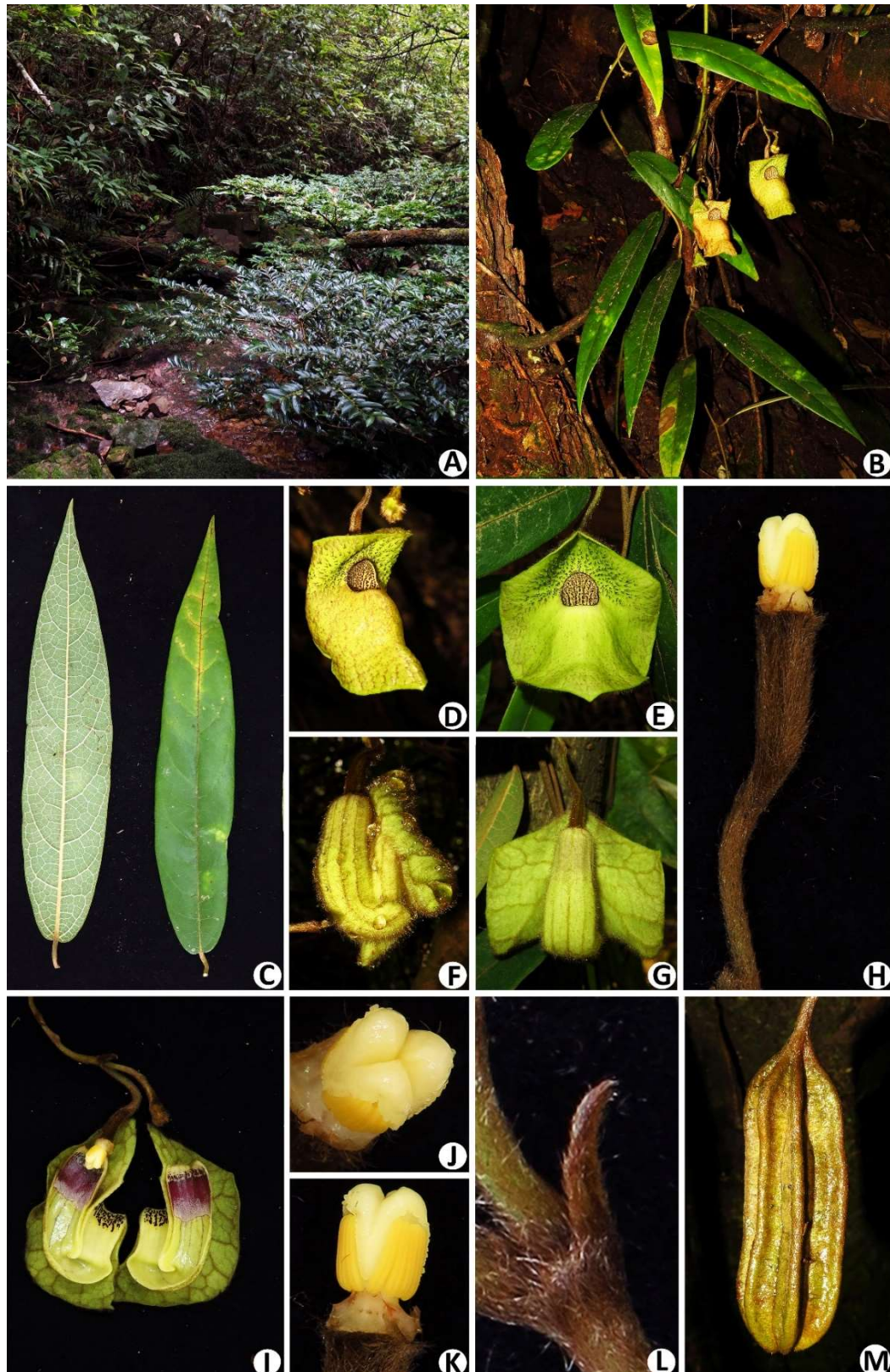


Fig. 2. *Isotrema haimingii* Y.S. Huang & Yan Liu, sp. nov. **A:** Habitat. **B:** Flowering branch. **C:** Leaf blades (adaxially and abaxially view). **D-E:** Flowers (front view, showing the calyx limb) **F:** Flower (lateral view). **G:** Flower (dorsal view). **H:** Ovary. **I:** Longitudinally dissected flower (showing the inside character). **J:** Gynostemium (vertical view). **K:** Anthers and gynostemium (lateral view). **L:** Bracteole. **M:** Capsule.



Capsule ellipsoid, 6–9 × 2–3 cm, 6-angled, densely yellowish-brown villous.

Phenology: The new species was observed flowering from May to August, and fruiting from July to October.

Etymology: The specific epithet is derived from Hai-Ming Tan, who has made important contributions to plant diversity conservation of Dayaoshan mountain in Guangxi, The Chinese name is given as “海明關木通” (pinyin: hǎi míng guān mù tōng).

Distribution and Habitat: At present, *Isotrema haimingii* was found only in Dayaoshan mountain of Guangxi, China. It grows in thick forests of hillside. The type locality is located in a valley, close to the river, and at an elevation of 1136 m. The slope direction is to the northwest and the slope gradient is up to 30°. The tree layer is up to 25 m tall and a canopy cover is 70%. The shrub layer cover is up to 80%, and the herb layer cover is just 40%. Its associated species include *Plagiogyria adnate* (Blume) Bedd. (Plagiogyriaceae), *Hymenophyllum barbatum* (Bosch) Baker (Hymenophyllaceae), *Cinnamomum appelianum* Schewe (Lauraceae), *Phyllagathis cavaleriei* (H. Lév. & Vaniot) Guillaumin and *Blastus cochinchinensis* Lour. (Melastomataceae), *Rubus panduratus* Hand.-Mazz. (Rosaceae), *Adinandra millettii* Benth. & Hook. f. ex Hance and *Eurya chinensis* R.Br. (Theaceae), *Rhododendron rivulare* Hand.-Mazz. (Ericaceae), *Castanopsis tibetana* Hance and *Castanopsis hystrix* Hook. f. & Thomson ex A. DC. (Fagaceae), *Meliosma squamulata* Hance (Sabiaceae) etc.

Conservation status: The distribution range of *Isotrema haimingii* is just on the Dayaoshan mountain of Guangxi, and 5 subpopulations have been recorded from 1931 to 2021. Although field investigations have been conducted in Dayaoshan mountain for more than ten years from 2010, just the subpopulation of type locality was found. Thus far, the population of *I. haimingii* just has four individuals in the type locality, including two mature ones. It obviously has very small population size. However, the good news is that the type locality is located in protected area, and all individuals are being well protected. The Extent of Occurrence (EOO) is ca. 470 km². The Area of Occupancy (AOO) known is 4 km². As a new species, however, field surveys are still limited. It is probable that more subpopulations should be found in similar habitats in the future. According to Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Committee, 2022), *I. haimingii* should be assessed as Endangered (EN) based on criteria B1ab (ii, iii, iv) (IUCN, 2012). How to protect this species is our ongoing research task.

Additional Specimens Examined (paratypes): CHINA, Guangxi Zhuang Autonomous Region: Jinxiu County, Jinxiu Town, protection station of Silver fir, 1136 m a.s.l., 23 July 2021, Y.S. Huang DYS2021072301 (IBK); the same County, Dayaoshan, 1200 m a.s.l., 3 July 1931, S.S. Sin 21644 (IBSC); the same County, Fenzhan Village, Banjiuchong, 27 August 1981, *Dayaoshan team 810668* (IBK, GXMI);

the same County, Jinxiu forest farm, 10 September 1981, *Dayaoshan team 810298* (IBK, GXMI); the same County, Dingbu Village, 10 September 1981, *Dayaoshan team 10376* (IBK) & *11577* (IBK, IBSC); the same County, Changdong Town, Dishui Village, Yinchong, 18 October 1981, *Dayaoshan team 810961* (IBK) & *11577* (IBK, GXMI); the same County, Liuxiang Town, Daling Village, Pinghuachong, 10 November 1981, *Dayaoshan team 811827* (IBK); the same County, Liuxiang Town, Shengtangwei, 10 November 1981, *Dayaoshan team 12449* (IBK); Guilin City, Botany Garden of Guilin, taken to cultivation from the type locality, 6 October 2020, Y.S. Huang Y3310 (IBK).

Notes: The specimens of *I. haimingii* were first collected from Dayaoshan mountain of Guangxi in 1931. During the scientific investigation in 1981, *I. haimingii* was found again and its specimens were collected. But all the specimens mentioned above have wrongly identified as *I. championii* because they are almost identical in morphology if without flowers and fruits. The tuber of *I. haimingii* has very important medicinal value, which can be used to treat sore throat, diarrhea and swine fever. That's why it is still being excavated by local residents. At present, the number of known distribution spots and mature individuals are very limited. Effective conservation measures must be taken to protect it. Meanwhile, we also contrasted the specimens of *I. championii* collected from Jiuwanshan Mountain, Nandan and Rong County of Guangxi, all of which are morphologically similar to *I. haimingii*. But we could not draw a conclusion that they are the same with *I. haimingii* because of lacking the proofs of fresh flowers and fruits.

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Supplementary materials are available from Journal Website.