

A new species of *Galearis* (Orchidinae: Orchidaceae) from Sichuan, China

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A new species, *Galearis huanglongensis* Q.W.Meng & Y.B.Luo, is described and illustrated. It is similar to *Galearis cyclochila* (Franch. & Sav.) Soó and *Galearis diantha* (Schltr.) P.F.Hunt, but differs in having a short spur, two elliptical lateral stigma lobes and distinctly separated bursicles. This new species is known only from the type locality, the Huanglong Valley, Songpan County, western Sichuan, China, growing amongst mosses under alpine shrubs at an elevation of about 3000 m. Based on two years of observations of its population size, the species was categorized as critically endangered CR (B1a, B2a) according to the World Conservation Union (IUCN) *Red List Categories and Criteria*, Version 3.1. The micromorphology of pollinia and seeds was observed by scanning electron microscopy and compared with that of *G. cyclochila* and *G. diantha*. The results supported *G. huanglongensis* Q.W.Meng & Y.B.Luo as a new species. © 2008 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2008, 158, 689–695.

ADDITIONAL KEYWORDS: conservation status – *Galearis huanglongensis* – habitats – population size.

INTRODUCTION

During the course of the examination of specimens of the genus *Orchis* L. and allied genera in the Chinese National Herbarium, Institute of Botany, Chinese Academy of Sciences (PE) in 2004, a collection of terrestrial orchids from the Huanglong Valley, Songpan County, western Sichuan, China, *Peng Li S04061501*, caught our attention. This plant had been identified previously as *Amitostigma monanthum* (Finet) Schltr. Having a creeping rhizome rather than tuberoids, however, it showed a striking resemblance to members of *Galearis* Raf. In order to obtain more plant material for comparison, the first author made two botanical trips, in 2005 and 2006, to the Huanglong Valley, Songpan County, and found several hundred individuals. This species is similar to *Galearis cyclochila* (Franch. & Sav.) Soó in having two subopposite flowers and a single leaf, and is also

similar to *Galearis diantha* (Schltr.) P.F.Hunt in having two lateral stigma lobes at the base of the column. However, is easily distinguished from *G. cyclochila* by having a short spur and two lateral stigma lobes at the base of the column and from *G. diantha* by having separated bursicles and white flowers. This orchid, therefore, represents a new species of the genus *Galearis*.

Galearis (Orchidaceae), a small genus of about six species, is distributed throughout the eastern Himalayas and the Hengduan Mountain region of China to Russia, Korea and Japan, with a single species, *Galearis spectabilis* (L.) Raf., occurring in North America (Seidenfaden & Arora, 1982; Lang, 1999; Perner & Cribb, 2002; Perner & Luo, 2007). This genus is characterized by having fleshy, creeping rhizomes and viscidia with distinct bursicles (Lang, 1999; Perner & Luo, 2007). The species of this genus are small- to medium-sized herbs, and usually grow in forests, alpine shrubs and alpine meadows in temperate regions of the Northern Hemisphere (Perner & Luo, 2007).

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MATERIAL AND METHODS

Living plants of *Galearis huanglongensis* were collected in the field, and the habitats and population size were investigated from 2004 to 2006. Herbarium specimens of *G. cyclochila* and *G. diantha* deposited in PE were checked for comparison.

Pollen samples of *G. diantha* (Q. W. Meng S06071602) and *G. huanglongensis* (P. Li S04061501) were taken from living plants, dehydrated in an ethanol series (Gerstberger & Leins, 1978), critical point dried in liquid CO₂, sputter coated with gold, and then examined and digitally photographed using a Hitachi S4800 scanning electron microscope. The pollen terminology follows Walker & Doyle (1975).

Seeds of *G. cyclochila* (W. Wang 886) were obtained from herbarium specimens kept at PE and seeds of *G. diantha* (X. Q. Yang S05082202) and *G. huanglongensis* (X. Q. Yang S05072204) were collected from plants in the field. Seed size was measured under a stereomicroscope (Nikon SMZ 1000). For scanning electron microscopy (SEM) observations, seeds were fixed to aluminium SEM stubs with double-sided adhesive tape and sputter coated with a gold-palladium alloy (Segarra & Mateu, 2001). The ultrastructure of seeds was examined and photographed using a Hitachi S800 scanning electron microscope. The terminology of seed surface sculpturing follows that of Kurzweil (1993) and Tohda (1983).

The conservation status of *G. huanglongensis* was assessed according to the World Conservation Union (IUCN) *Red List Categories and Criteria*, Version 3.1. All voucher specimens were deposited at PE.

RESULTS

GALEARIS HUANGLONGENSIS Q.W.MENG & Y.B.LUO, *SP. NOV.* (FIGS 1–3)

Type: China, Sichuan: Songpan County, Huanglong Valley, c. 3020–3100 m, latitude 32°45'N, longitude 103°49'E, 15.vi.2004, P. Li S04061501 (holotype, PE; isotypes, PE); the same locality, Q. W. Meng MS080 (paratype, PE).

Diagnosis: *Galeari cyclochilae* (Franch. & Sav.) Soó et G. dianthae (Schltr.) P.F.Hunt similis, sed ab illa calcaris brevis (0.2 cm), stigmatibus 2 lateralibus ellipticis instructo (non indiviso), ab hac folio singulari (non plerumque 2), floribus plerumque 2 suboppositis albis (non 2–5 in inflorescentia laxa), bursiculis manifeste separatis, stigmatibus 2 lateralibus ellipticis instructo, differt.

Notes: *Galearis huanglongensis* is similar to *G. cyclochila* (Franch. & Sav.) Soó and *G. diantha* (Schltr.) P.F.Hunt, but distinguishable from the former by having a short spur and two elliptical

lateral stigma lobes, and from the latter by having two subopposite flowers, distinctly separated bursicles and elliptical lateral stigma lobes.

Description: Terrestrial herb, 6–10 cm tall, glabrous throughout. RHIZOME terete, horizontally creeping, fleshy. STEM erect, green, enveloped by two scarious, blunt, tubular sheaths at base. LEAF solitary, basal; petiole 1.0–4.1 cm long; blade suborbicular, ovate to elliptical, 2.2–5.2 × 1.0–3.3 cm, apex obtuse, base rounded. INFLORESCENCE usually two-flowered, rarely one-flowered. FLOWERS white; bracts leaf-like, elliptical to ovate, 1.0–2.4 × 0.3–1.0 cm, acuminate; ovary fusiform, slightly twisted, combined with pedicel 0.8–1.0 cm long; dorsal sepal erect, ovate-oblong, 0.5 × 0.2 cm, acuminate, three-veined; lateral sepals narrowly falcate, 0.5 × 0.1 cm, one-veined, adnate to dorsal sepal and forming a hood; petals falcate-ovate, 0.5 × 0.1–0.2 cm, one-veined; labellum white, entire, suborbicular-ovate to broadly ovate, 0.6–0.7 × 0.5 cm, obtuse, margin crenate, sparsely red-spotted or patched on the upper surface; spur stout-short, cylindrical, 0.2 cm long. Column short, stout, with two elliptical lateral stigma lobes; pollinia two, each with a caudicle and viscidium enclosed in distinctly separated bursicle. OVARY cylindrical or subglobose, 0.8–1.6 cm long, 0.2–0.5 cm in diameter.

Phenology: Flowering from May to June and fruiting from June to July.

Ecology, distribution and conservation status: *Galearis huanglongensis* is known only from its type locality, the Huanglong Valley, Songpan County, western Sichuan, China. It grows amongst mosses under *Berberis diaphana* Maxim. at an elevation of c. 3000 m. The accompanying plants include several other orchids, *Ponerorchis chusua* (D.Don.) Soó, *G. diantha* (Schltr.) P.F.Hunt, *Cypripedium flavum* P.F.Hunt & Summerh. and *Phaius delavayi* (Finet) P.J.Cribb & Perner, and a species of Ericaceae, *Arctous rubra* (Rehder & E.H.Wilson) Nakai.

In the Huanglong Nature Reserve, only about 300 individual plants of *G. huanglongensis* have been found in a small area of 0.05 km². According to the IUCN *Red List Categories and Criteria*, Version 3.1 (IUCN, 2001), *G. huanglongensis* should be categorized as a critically endangered species: CR (B1a, B2a). In view of the small population size and the possible impacts from the increasing number of tourists to this well-known scenic spot, much attention should be paid to the conservation of this species in the future.

Etymology: The epithet '*huanglongensis*' refers to the name of the type locality of this new species, i.e. the Huanglong Valley.

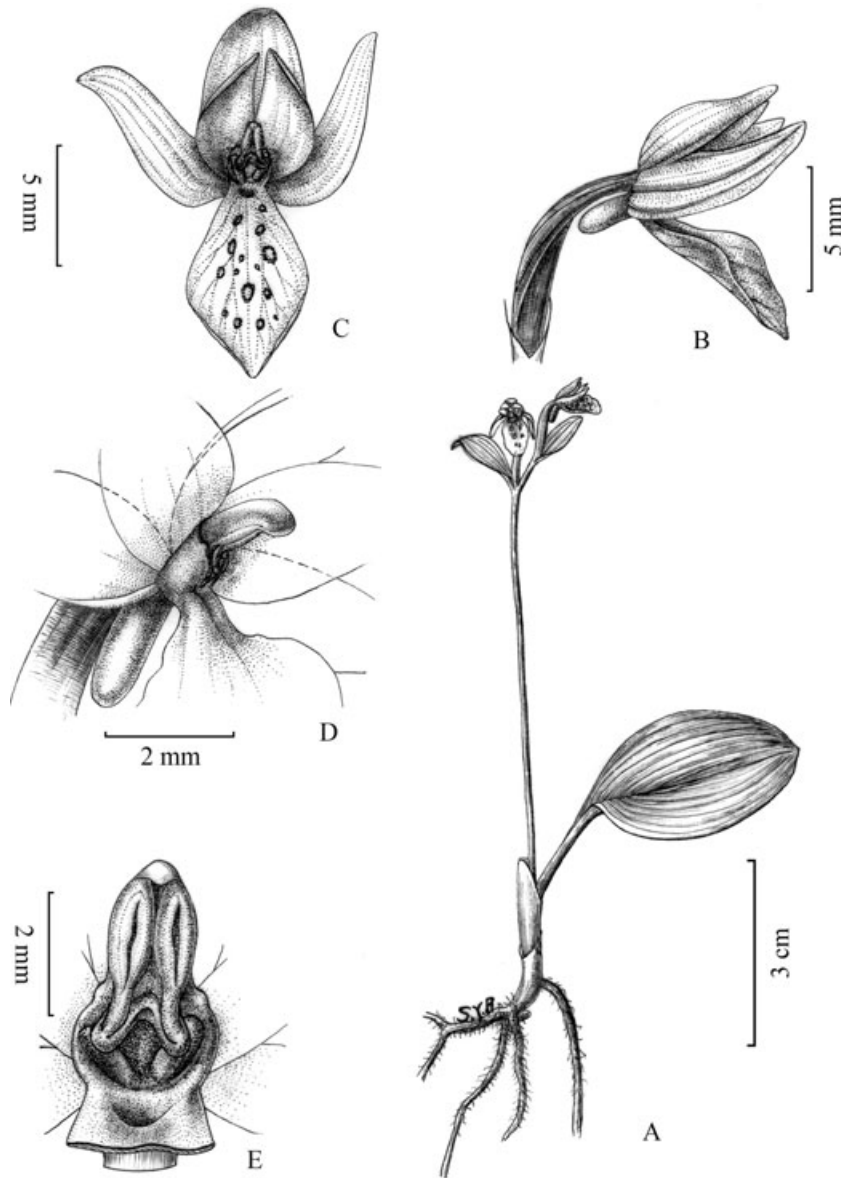


Figure 1. *Galearis huanglongensis* Q.W.Meng & Y.B.Luo: A, habit; B, flower, showing a spur, lateral view; C, flower, showing labellum, petals and sepals, front view; D, column, showing extension of stigma lobes, lateral view; E, column, showing two lateral stigma lobes and two separated bursicles, front view. Drawn from *P Li S04061501* and *Q. W. Meng MS080* by Mr Y. B. Sun.

Additional specimens examined: CHINA. Sichuan, Songpan County, Huanglong Valley, altitude c. 3020–3100 m, latitude 32°45'N, longitude 103°49'E, 18.vi.2006, *Qian-Wan Meng MS080* (PE).

Palynology: Like most species in tribe Orchideae, the pollen grains of *G. diantha* and *G. huanglongensis* are typically maintained as isodiametric tetrads united into a massula (Figs 4, 5, 9, 10). Within subtribe Orchidinae, the exine sculpturing of the massula shows great diversity and is of taxonomic significance

at the species level (Caspers & Caspers, 1976; Schill & Pfeiffer, 1977; Pridgeon *et al.*, 2001; Lumaga, Cozzolino & Kocyan, 2006). *Galearis diantha* has both laevigate-scabrate (Figs 6, 7) and laevigate-rugulate (Fig. 8) types of exine sculpturing, whereas *G. huanglongensis* has only the laevigate-scabrate type (Fig. 11).

Seed morphology: Judging from the size and shape of the seed and testa cell, and the surface structure of the testa, of the three species studied, their seed

morphology belongs to either the *Orchis* (Dressler, 1993) or the *Satyrium* type (Kurzweil, 1993). The seeds of *G. huanglongensis* are elliptical (Figs 19, 20), similar to those of *G. cyclochila* (Fig. 12), but different from those of *G. diantha*, which are obovate or short-fusiform (Figs 15, 16; Table 1). However, the surface of the testa cells of *G. diantha* and *G. huanglongensis* (Figs 17, 18, 21, 22) is smooth, different from that of *G. cyclochila*, which is sculptured with slightly slanting transverse ridges of wall thickening (Figs 13, 14).

The transverse ridges observed here on the seed coats of *G. cyclochila* were not reported by Tohda (1983).

DISCUSSION

In terms of gross morphology, *G. huanglongensis* can be distinguished from other *Galearis* species by having two elliptical lateral stigma lobes and distinctly separated bursicles. As shown in Table 2, this species is more similar to *G. cyclochila* than to



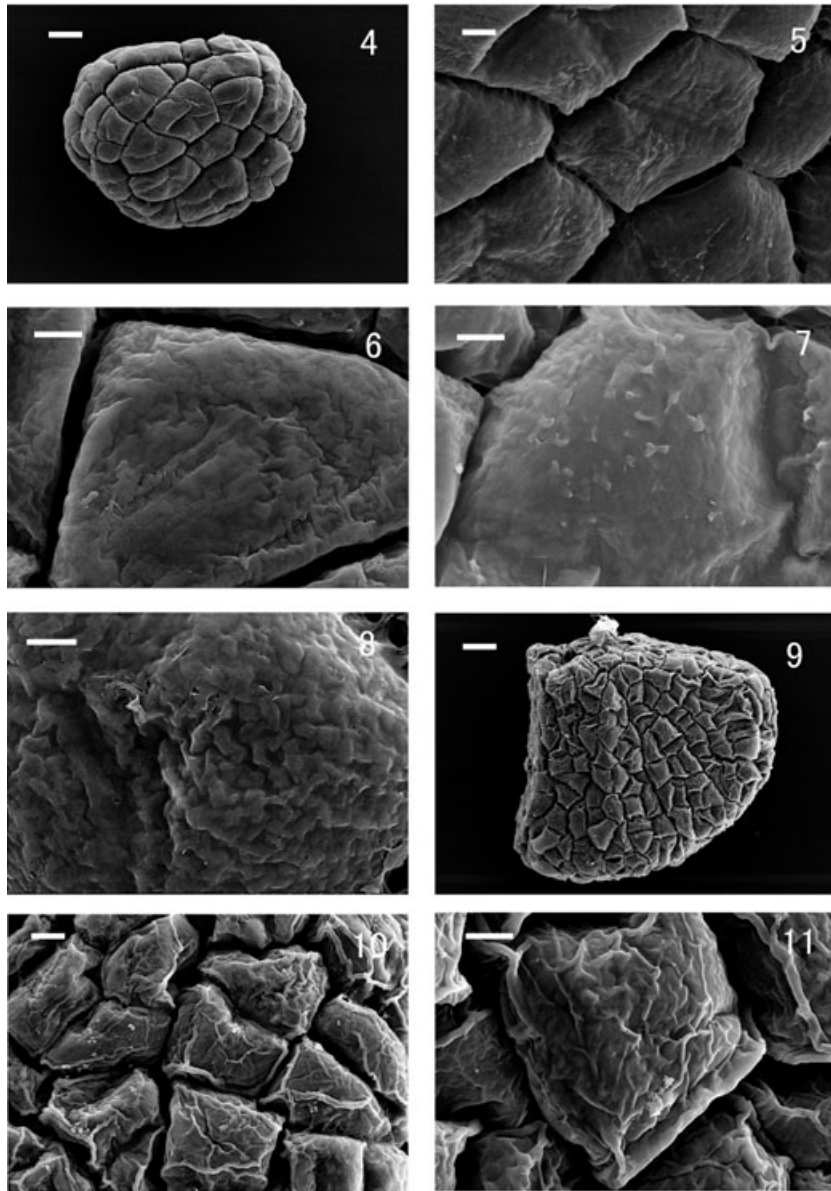
Figure 2. Flowering plants of *Galearis huanglongensis* in natural habitat.



Figure 3. Fruiting plants of *Galearis huanglongensis* in natural habitat.

Table 1. Seed characters of *Galearis cyclochila*, *G. diantha* and *G. huanglongensis*

Character	<i>G. cyclochila</i>	<i>G. diantha</i>	<i>G. huanglongensis</i>
Seed shape	Elliptical	Obovate	Elliptical
Seed length (<i>L</i> , mm)/SD	0.374/0.020	0.415/1.228	0.359/0.034
Seed width (<i>W</i> , mm)/SD	0.097/0.020	0.115/0.387	0.104/0.012
Ratio (<i>L/W</i>)/SD	3.22/0.65	3.03/0.40	3.67/0.59
Number of testa cells at long axis	7.1	4.8	7.5
Number of testa cells at wide axis	6.0	6.9	5.0
Periclinal walls	Slanting, transverse ridges	Smooth	Smooth
Anticlinal walls	Slanting, longitudinal ridges	Straight	Straight



Figures 4–11. Scanning electron microscopy of pollen exine sculpturing of *Galearis diantha* and *G. huanglongensis*. Figs 4–8. *G. diantha*: trigonous-conical massula, tetrads and laevigate-scabrate, laevigate-rugulate sculpturing. Figs 9–11. *G. huanglongensis*: tetragonous-conical massula, tetrads and laevigate-rugulate sculpturing. Scale bars: Figs 4, 9, 20 μm ; Figs 5, 10, 5 μm ; Figs 6–8, 11, 3 μm .

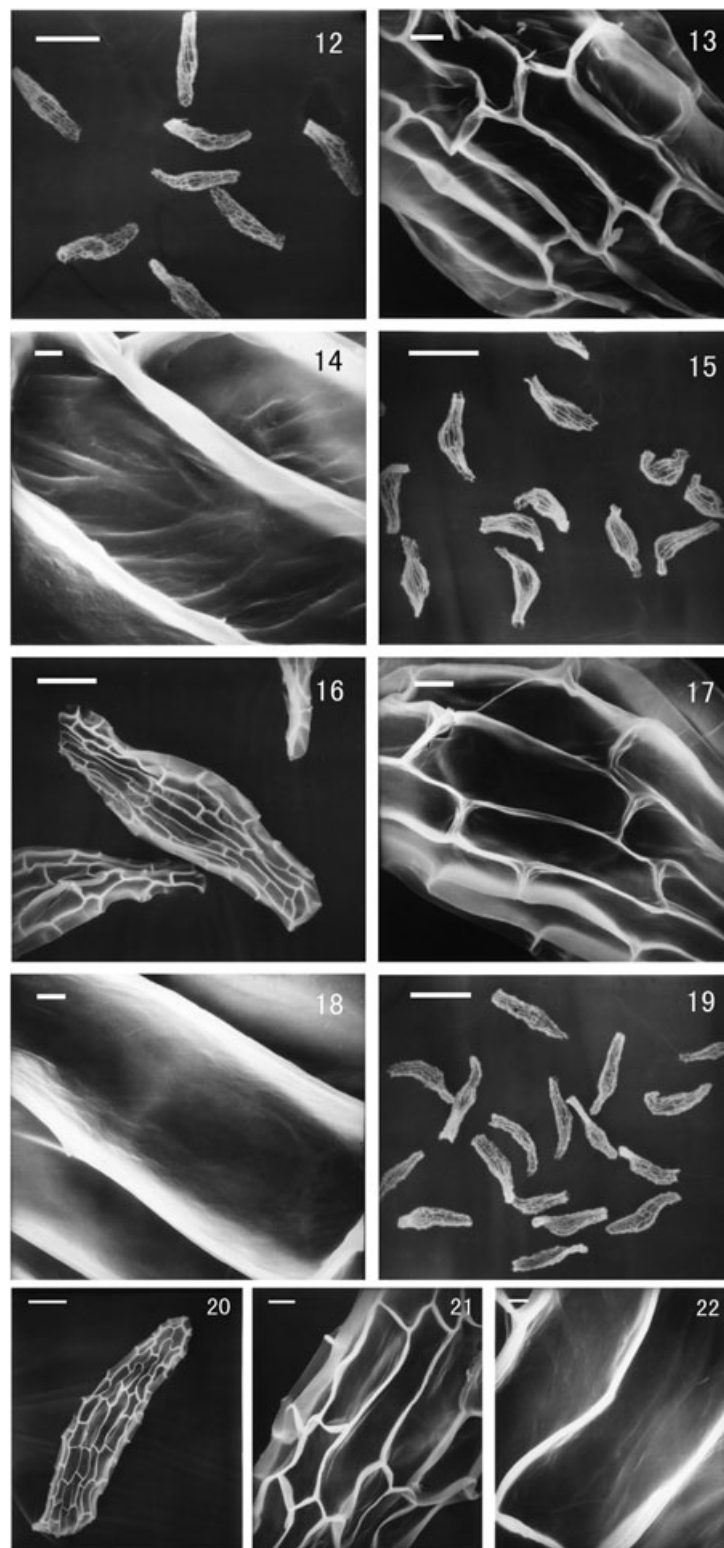
G. diantha in general appearance and in the two subopposite flowers and a single leaf. *Galearis diantha* usually has two leaves, a two- to five-flowered lax inflorescence and a short, cylindrical spur. In terms of stigma structure, however, *G. huanglongensis* is more similar to *G. diantha* in having separate stigma lobes. *Galearis cyclochila* has an undivided stigma.

Palynologically, *G. diantha* and *G. huanglongensis* have in common the laevigate-scabrate type of exine sculpturing. In terms of seed coat micromorphology,

however, *G. huanglongensis* is more similar to *G. diantha* than to *G. cyclochila*. This indicates that these three species, as members of *Galearis*, are possibly related to each other.

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Figures 12–22. Scanning electron microscopy of seed morphology of *Galearis cyclochila*, *G. diantha* and *G. huanglongensis*. Figs 12–14. *G. cyclochila*: seeds, testa cells and slanting traverse ridges on anticlinal walls. Figs 15–18. *G. diantha*: seeds, one seed, testa cells and smooth sculpturing. Figs 19–22. *G. huanglongensis*: seeds, one seed, testa cells and smooth sculpturing. Scale bars: Figs 12, 15, 19, 500 μm ; Figs 16, 20, 100 μm ; Figs 13, 17, 21, 20 μm ; Figs 14, 18, 22, 5 μm .

Table 2. Comparison of the diagnostic characters of *Galearis cyclochila*, *G. diantha* and *G. huanglongensis*

Character	<i>G. cyclochila</i>	<i>G. diantha</i>	<i>G. huanglongensis</i>
Leaf number	1	Usually 2, rare 1 or 3	1
Leaf size (cm)	5–9 × 2–5	2–9 × 0.5–3	2.2–5.2 × 1.0–3.3
Inflorescence	Two-flowered; subopposite	Usually two- to five-flowered; lax alternate	Two-flowered; subopposite
Flower colour	Pink, rare white	Purple, pink	White
Labellum	Without ornament	Ornamented	Ornamented
Spur shape	Slender, cylindrical	Short, cylindrical	Stout-short, cylindrical
Spur length (mm)	9–13	2	2–2.5
Pollinia	Two, each enclosed in integrated bursicle	Two, each enclosed in integrated bursicle	Two, each enclosed in separated bursicle
Stigma	Without stigma lobes	Two ligulate, lateral stigma lobes	Two elliptical, lateral stigma lobes

labelling the scale bars. We wish to show our appreciation to Dr Peng Li for his photographs of the plants and to Mrs Xiao-qin Yang for her help with the collection of plant material. This study was supported by grants from the Chinese Academy of Sciences (Key Innovation Plan kzcx2-yw-415), and by the Co-Researching Station of the Institute of Botany, Chinese Academy of Sciences and Huanglong Administration of National Scenic Spots, Sichuan, China.

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