

# *Aster shennongjiaensis* (Asteraceae), a new species from central China

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**Abstract.** A new species of *Aster* (Asteraceae) from China, *Aster shennongjiaensis* W. P. Li et Z. G. Zhang, is described and its morphology and karyotype illustrated. *Aster shennongjiaensis* is apparently endangered, presently known only from one small population in bamboo forests of Shennongjia Reserve in central China. On a morphological basis, the closest species to *A. shennongjiaensis* is *A. lasiocladus* Hayata, but they are quite different in many features. The morphological characteristics of the two species are compared. Karyotype of the new species is described and formulated as  $2n = 2x = 18 = 16m + 2sm$ .

**Keywords:** Asteraceae; *Aster shennongjiaensis*; China; Diploid; Endangered species; Karyotype; New species.

## Introduction

Shennongjia, a Biosphere Reserve of central China, is situated between longitude 109°56'-110°58' E and latitude 31°15'-31°57' N. This area has an archaic geological history, a complex and isolated topography, and complex climatic conditions. The mean elevation is 1,700 m, the annual mean temperature 10-12 °C, and the annual precipitation about 1,200 mm. An extremely diverse vascular flora inhabits this reserve with 2,638 species and infraspecific taxa belonging to 850 genera and 193 families (Zheng, 1993), making the reserve one of the three richest regions of plant diversity in China and a Biosphere Reserve.

During botanical exploration and conservation studies in Shennongjia Reserve in 1997, we collected an unknown taxon assignable to the genus *Aster*. After further field observations and collections and thorough consultation of *Flora Reipublicae Popularis Sinicae* (Ling and Chen, 1985), *Plantae Sinenses* (Handel-Mazzetti, 1938), Flora of Japan (Ito and Soejima, 1995), and Flora of Taiwan (Soejima and Peng, 1998a), and after comparisons with the herbarium specimens of *Aster* species in the PE, WUK, SZ, CDBI, HNNU, KUN, IBSC, IBK, NAS, HGAS, CCNU, HIB, HIMC, and FUS herbaria, we concluded that the taxon is a new species of the series *Ageratoides* (Asteraceae, *Aster* L., sect. *Orthomeris* A. Gray).

The series *Ageratoides* Kitam. is distributed mainly in East Asia (Ling and Chen, 1985). On the Chinese mainland, the series is represented by ten species (Ling and Chen,

1985; Soejima and Peng, 1998a), among which seven are endemic, that is, *Aster homochlamydeus* Hand.-Mazz., *A. menelii* Levl., *A. alatipes* Hemsl., *A. dolichophyllus* Ling, *A. hunanensis* Hand.-Mazz., *A. limosus* Hemsl., and *A. moupinensis* (Franch.) Hand.-Mazz.. The last five species are restricted to central China, and this is, therefore, one of centers of the series for speciation.

## Materials and Methods

Field observations and collections were made four times respectively on 10 July 1997, 29-30 July 2000, 28-29 October 2000, and 14-15 September 2001 in Shennongjia Reserve, Hubei Province in central China. We collected 35 individuals of the new species, among which 25 were prepared for morphological analysis as specimens that were deposited in the Herbarium of Hunnan Normal University (HNNU), and 10 were cultivated at Hunan Normal University to be used for cytological investigations.

Actively growing root tips 5 mm long were cut and pre-treated with 0.1% colchicine at about 20°C for 4 h before being fixed in Carnoy I (glacial acetic acid: 95% ethanol = 1:3) at 5°C for 12 h, then macerated in a 1:1 mixture of 1 mol/L hydrochloric acid and 45% acetic acid at 60°C for 2 min, and finally stained and squashed in 1% aceto-orcein.

The karyotype parameters came from the data of the chromosome characters of ten somatic metaphase cells from the ten plants. The symbols used to describe the karyotype followed Levan et al. (1964): m = median-centromeric chromosome (arm ratio: 1-1.70); sm = submedian-centromeric chromosome (arm ratio: 1.71-3.00). The symmetry of karyotype was classified according to Stebbins (1971).

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## Results and Discussion

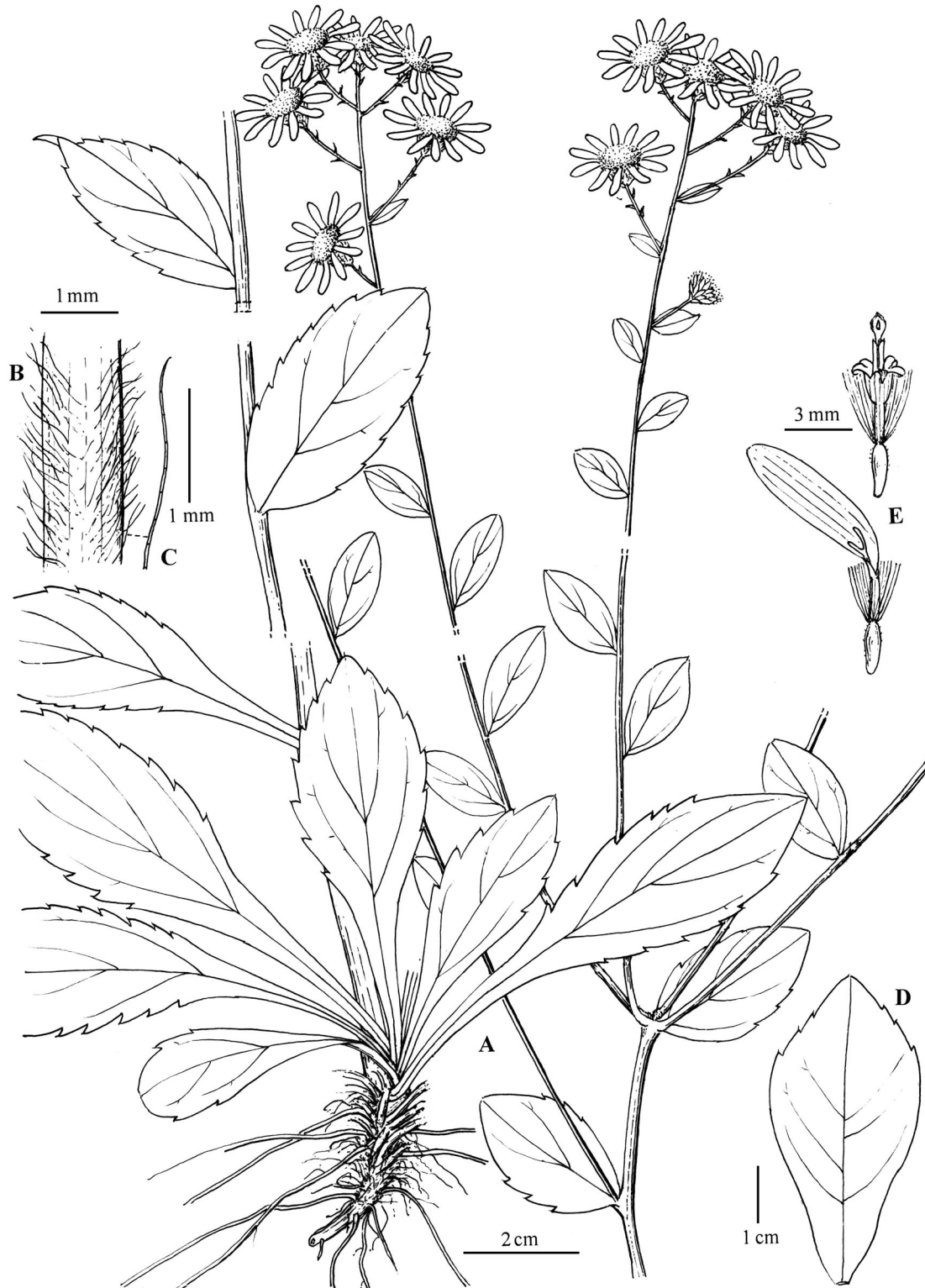
### Description

*Aster shennongjiaensis* W. P. Li et Z. G. Zhang, sp. nov.—TYPE: CHINA. Hubei Prov.: Shennongjia

Reserve, alt. 450 m, 14 Sep 2001, *Wei-Ping Li 0776695* (holotype: HNNU; isotype: HNNU). 神農架紫菀

(Figure 1)

Species *Aster lasiocladus* Hayata affinis, sed differt rhizomate horizontali absente, foliorum vaginis ad basin



**Figure 1.** *Aster shennongjiaensis* W. P. Li et Z. G. Zhang (drawn by Ya-Ling Hu). A, Habit; B, Middle portion of stem, showing villi; C, Hair from middle portion of stem; D, Middle cauline leaf; E, Disc floret (upper) and ray floret (lower). (A, B, C, and E from the holotype; D from the isotype)

caulium dense remanentibus, caulibus in medio villosis, calathidiis plerumque in racemo dispositis, involucri phyllariis interioribus dorsaliter glabris, ramentis alveolorum receptaculi brevioribus, et pappi brevioribus.

Herbs perennial with no horizontal rhizome. Stems erect, 40-75 cm tall, usually 3-6-branched above, villous (hairs usually 0.5-2 mm long). Leaves distinctly 3-nerved, yellow glandular punctate on low surface; radical leaves rosulate, base attenuate into a clearly winged petiole, withered before anthesis, and the persistent leaf sheath remains forming dense dark scales; lower cauline leaves oblong or obovate with a winged petiole, usually withering at anthesis; middle leaves obovate, oblong, or sometimes spatulate, 4.5-9 cm long, 2-3.6 cm wide, sessile or subsessile, margins entire or serrate with 1-8 pairs of teeth, densely hispidulous on upper surface, densely velutinous on lower surface; leaves on branches much smaller, 1-4.4 cm long, 0.5-2 cm wide, ovate or elliptic, margins entire or serrulate, sessile or subsessile. Heads few to many usually in racemes, sometimes in corymbs, peduncle 0.4-2.3 cm long with some scales. Involucre campanulate to hemispheric, bracts green at apex, 1-nerved, margins scarious and ciliolate, 4-seriate, inner ones glabrous on the dorsal surface, and the others lanuginous more or less. Chaffs of alveoli on clinanthium extremely short, 0.06-0.18 mm long. Ray florets 7-11 in one row, two stigmata different in length, ligules usually reddish purple, 6-9 mm long, 0.9-1.7 mm wide, 3-denticulate at apex, (3-)4(-5)-veined, tube 1.25-2 mm long. Disc florets 12-22, corolla yellow, tube 2.2-2.8 mm long. Pappus dirty white in 1 series, 2-2.7 mm long in ray florets, 2.5-3.0 mm long in disc florets. Achenes lanceolate-obovate, slightly flattened, 2.0-3.3 mm long, 0.9-1.2 mm wide, strigose. Flowering Jul-Sep; fruiting Sep-Nov.

### Habitat

The vegetation type of this new species' habitat is bamboo forests at 450-500 m elevation in Shennongjia Reserve, dominated by *Phyllostachys nigra* var. *henonis* (Mitf.)

Stapf ex Rendle. The herbaceous layer is dominated by a few shade-enduring grass species.

According to our field observations, there are no more than 300 plants of this species in Shennongjia Reserve. Furthermore, since the first discovery of the new species in the type locality in 1997, we have searched for it three times in areas surrounding the reserve, but no populations of *A. shennongjiaensis* have been found there. Therefore, this new species should be assigned to the Endangered (EN) category because of the single population and its small size.

### Relationships

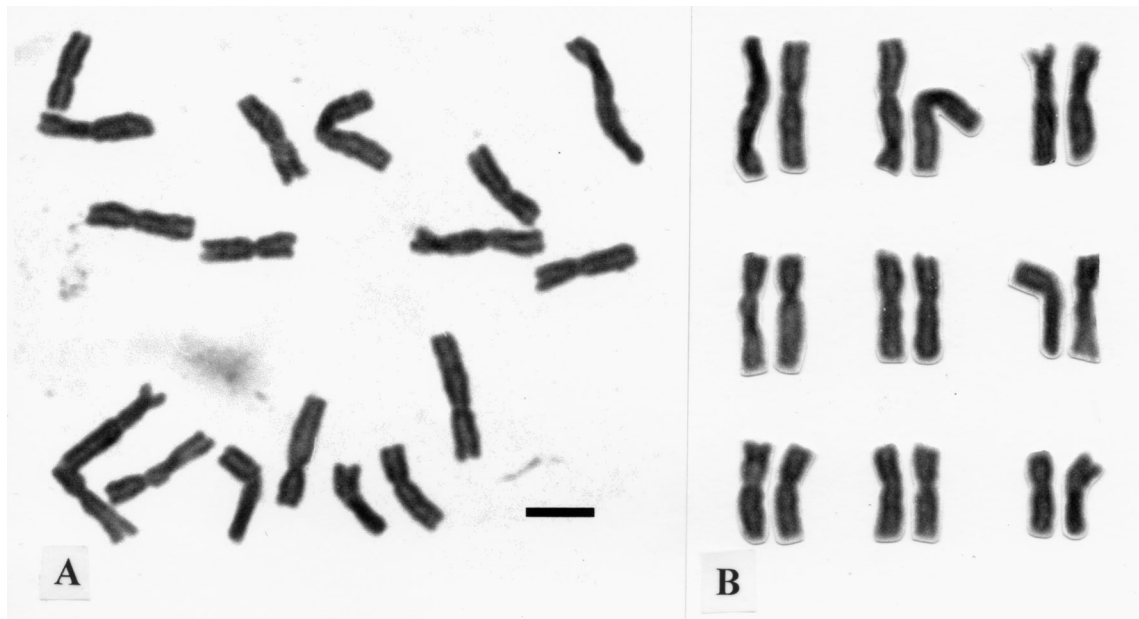
*Aster shennongjiaensis* belongs to ser. *Ageratoides* (Asteraceae, *Aster* L., sect. *Orthomeris* A. Gray) because of its triplinerved leaves, campanulate or hemispheric involucre, 4-seriate bracts with longer inner bracts, lanceolate-obovate achenes, and dirty-white pappus. On a morphological basis, the closest species to *Aster shennongjiaensis* is *A. lasiocladus* Hayata. Both are densely villous on stems and lower surface of leaves, glanduliferous on lower surface of leaves, slightly dimorphic in pappus, and heterostigmatic in the same ray floret. However, *A. shennongjiaensis* can be easily distinguished from *A. lasiocladus*. A morphological comparison between *A. shennongjiaensis* and *A. lasiocladus* is given in Table 1.

### Karyotype

Observations of somatic mitosis at metaphase reveal that the chromosome number of *A. shennongjiaensis* is  $2n = 18$  (Figure 2) like *A. lasiocladus* (Soejima and Peng, 1998b). Since the basic chromosome number was reported to be  $x = 9$  in the genus *Aster* (Huziwara, 1957; Soejima and Peng, 1998b; Li and Liu, 2002; Li, 2002; Li, 2003), *A. shennongjiaensis* is considered to be diploid. The chromosomes vary in length gradually from 7.92 to 4.89  $\mu\text{m}$ , the ratio of the length of the longest and the shortest chro-

**Table 1.** Comparison between *Aster shennongjiaensis* and *A. lasiocladus*.

Features	<i>Aster shennongjiaensis</i>	<i>Aster lasiocladus</i>
Horizontal rhizome	None	Usually present
Growth habit	Single	Single or caespitose
Stems	46-75 cm long	30-120 cm long
Sheaths of radical leaves	Marcescent	Deciduous
Hairs on middle part of stem	0.5-2 mm long	0.2-0.64 mm long
Middle leaves	Obovate, oblong, or spatulate; 4.5-9 cm long, 2-3.6 cm wide	Oblong or ovate; 6.4-14.3 cm long, 1.8-4.5 cm wide
Arrangement of heads	Usually racemiform, sometimes corymbiform	Corymbiform
Dorsal surface of inner phyllaries	Glabrous	Pubescent on upper part
Chaffs of alveoli on clinanthium	0.06-0.18 mm long	0.26-0.51 mm long
Ligules of ray florets	Reddish purple	White, sometimes reddish purple
Corolla tubes of ray florets	1.25-2 mm long	2-2.5 mm long
Pappus	2.0-3.0 mm long	3.3-5.0 mm long
Distribution	Localized in Shennongjia Reserve, Hubei, China	Distributed widely south of the 33 degree north latitude and east of the 111 degree east longitude in China



**Figure 2.** Micrographs of somatic chromosomes of *Aster shennongjiaensis* at metaphase (bar = 4  $\mu$ m). A, Metaphase chromosomes; B, Karyotype.

**Table 2.** Parameters of mitotic metaphase chromosomes of *Aster shennongjiaensis*.

Chromosome No.	Relative length	Arm ratio	Type
1	8.52 + 5.29 = 13.81	1.61	m
2	7.53 + 5.34 = 12.87	1.41	m
3	6.50 + 5.78 = 12.28	1.13	m
4	7.71 + 4.25 = 11.96	1.82	sm
5	6.02 + 4.65 = 10.67	1.30	m
6	6.61 + 3.97 = 10.58	1.67	m
7	5.66 + 4.22 = 9.88	1.34	m
8	5.45 + 4.00 = 9.45	1.36	m
9	4.98 + 3.55 = 8.53	1.41	m

mosome is 1.62, and there is no chromosome with an arm ratio of more than 1.70 except the fourth longest pair (Table 2), indicating that the species has a relatively low inter-chromosomal and intrachromosomal asymmetry. We found no secondary constriction in this new species while the longest chromosome pair of *A. lasiocladus* has that on its short arm (Soejima and Peng, 1998b). The karyotype of *A. shennongjiaensis* is formulated as  $2n = 2x = 16m + 2sm$  and belongs to Stebbins' 1A type because the ratio of the length of the longest chromosome to the shortest is below 2, and no arm ratio is more than 2 (Table 2).

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## 中國中部菊科新種植物：神農架紫菀

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本文報導了菊科一新種：神農架紫菀 (*Aster shennongjiaensis* W. P. Li et Z. G. Zhang)。該種屬紫菀屬 (*Aster* L.) 正菀組 (sect. *Orthomeris* A. Gray) 三脈葉系 (ser. *Ageratoides*)。文中對神農架紫菀的形態學特徵和核型特徵進行了描述，並配以墨線圖和顯微照片。目前該種只在神農架海拔 450-500m 處發現有一個種群，而且個體數不超過 300 株，因而屬於瀕危物種。從形態上看與神農架紫菀最相似的種是絨山白菊 (*Aster lasiocladus* Hayata)，但二者在許多特徵上顯著不同。本文比較了二種的形態特徵。神農架紫菀是二倍體，核型公式為  $2n = 2x = 18 = 16m + 2sm$ 。

**關鍵詞：**菊科；神農架紫菀；中國；二倍體；瀕危種；核型；新種。