

New Contributions to the Flora of Beijing, China

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Abstract: Plant diversity is the basis of human survival and development. Beijing, the capital of China, has been experiencing rapid urbanization and development, and the conservation of its biodiversity is being threatened. It is urgent to strengthen the survey of biodiversity in order to take more effective measures for protection. To evaluate the current state of plant diversity in Beijing, we carried out a large-scale field investigation in the last ten years. The line-transect and quadrat methods were used, with the regional grid (10 km×10 km) as a survey unit. In this paper, new forms of three plant species with white flowers are described, namely, *Gentiana macrophylla* f. *alba* (Gentianaceae), *Pedicularis spicata* f. *alba* (Orobanchaceae), and *Elsholtzia densa* f. *alba* (Lamiaceae). They are all important ornamental plant resources. In addition, four newly recorded species from Beijing, including *Aleuritopteris grisea*, *Polypodium sibiricum*, *Androsace incana*, and *Sida spinosa*, are discussed. This study provides an important contribution to the flora of Beijing. The results show that Beijing has a relatively rich and complex flora in North China. With increased field expeditions, more new records will be discovered. It is noteworthy that the number of alien invasive species shows a sustained increasing trend. They may have harmful impacts on the local ecosystem, and should be paid particular attention in the future researches.

Keywords: New Record, New Form, Flora, Beijing

1. Introduction

Beijing, the capital of China, is located at the intersection of the Taihang Mountains and Yanshan Mountains. Although it encompasses a small area of only about 16,000 km², it has a relatively rich and complex flora in North China, resulting in the collection of many plant specimens by botanists. *The Flora of Beijing*, in which 2,088 species were recorded, is one of the earliest records of the local flora of China [2]. It has played an important role in botanical teaching, scientific research, and the protection and utilization of plant resources in this area. Since 1980s, with increased field botany expeditions, many new records have been reported, and most of them are mountain plants [5, 6, 8, 9, 11, 12]. Wetland plants are also an important part of Beijing flora, with about 786 species [16]. Amongst them, more than 20 species were firstly recorded from Beijing [1, 18]. Urbanization can result in destruction of

the original ecosystem, and is considered as the main cause for the increase of alien species in modified landscapes [19]. 91 species of invasive plants belonging to 25 families were identified in Beijing [7], and the new invasive species are still being continuously found [4]. All the above researches enrich the floral data of Beijing.

Biodiversity is the basis of human survival and development [17]. As a cosmopolitan city with a long history, Beijing has been experiencing rapid urbanization and development, and the conservation of its biodiversity is being threatened [15]. Therefore, it is urgent to strengthen the survey of biodiversity, which is of great significance for further effective protection and the ecological quality assessment [3, 14]. Unfortunately, the past investigation is still unsatisfactory in some key areas. To evaluate the current state of plant diversity in Beijing, we carried out a

large-scale field investigation and discovered three new forms of vascular plants with white flowers (*Gentiana macrophylla* Pall. of Gentianaceae, *Pedicularis spicata* Pall. of Orobanchaceae, and *Elsholtzia densa* Benth. of Lamiaceae). In addition, four known species were recorded for the first time from Beijing, namely, *Aleuritopteris grisea* (Blanford) Panigrahi, *Polypodium sibiricum* Sipliv., *Androsace incana* Lam., and *Sida spinosa* L. All voucher specimens cited in this paper were deposited in the herbarium of the Beijing Forestry University (BJFC). This work contributes to our knowledge of the flora of Beijing, China.

2. Results

2.1. *Gentiana macrophylla* Pall. f. *alba* G. M. Zhang, f. nov. (Figures 1-A, 3)

A typo differt corollis albis, non caeruleo-purpureis.

Type: —CHINA. Beijing: Mentougou District, Dongling Mountain, 40°01.81'N, 115°27.26'E, 2268 m elev., 19 July 2009, Y. Wang QS-276 (holotype, BJFC).

Notes. The new form differs from the original *G. macrophylla* by its white flowers instead of blue flowers. It was observed to grow on the high-altitude meadow and was usually accompanied by *Saussurea iodostegia* Hance, *Carex capillaris* L., *Leontopodium smithianum* Ling, and *Caragana jubata* (Pall.) Poir.

Gentiana macrophylla is an important ornamental species, and its roots are used in Chinese medicine.

2.2. *Pedicularis spicata* Pall. f. *alba* G. M. Zhang, f. nov. (Figures 1-B, 3)

A typo differt corollis albis, non purpureis.

Type: —CHINA. Beijing: Yanqing District, Songsan Mountain, 40°33.94'N, 115°48.88'E, alt. 2023 m, 3 Aug 2009, Y. Wang et al. 0908135 (holotype, BJFC).

Notes. The new form differs from the original *P. spicata* by its white flowers instead of purple-red flowers. It was observed to grow on the high-altitude meadow and was usually accompanied by *Trigonotis peduncularis* var. *amblyosepala* (Nakai & Kitag.) W. T. Wang, *Delphinium grandiflorum* L., *Dracocephalum rupestre* Hance, *Saussurea ussuriensis* Maxim., and *Bupleurum smithii* H. Wolff.

Pedicularis spicata is an important ornamental species in the subalpine meadow of Beijing, with purple-red flowers and whorled leaves.

2.3. *Elsholtzia densa* Benth. f. *alba* G. M. Zhang, f. nov. (Figures 1-C, 3)

A typo differt corollis albis, non purpureis.

Type: —CHINA. Beijing: Mentougou District, Dongling Mountain, 40°01.75'N, 115°29.65'E, alt. 1471 m, 22 Aug 2010, G. M. Zhang 201008002 (holotype, BJFC).

Notes. The new form differs from the original *E. densa* by its white flowers instead of purple flowers. It was observed to

grow in meadows or on the forest edge and was usually accompanied by *Dendranthema chanelii* (H. Lév.) C. Shih, *Callistephus chinensis* (L.) Nees, and *Betula platyphylla* Suk., *Phlomis umbrosa* Turcz.

Elsholtzia densa is a common plant species on the high-altitude meadow, with purplish flowers and cylindrical spikes.

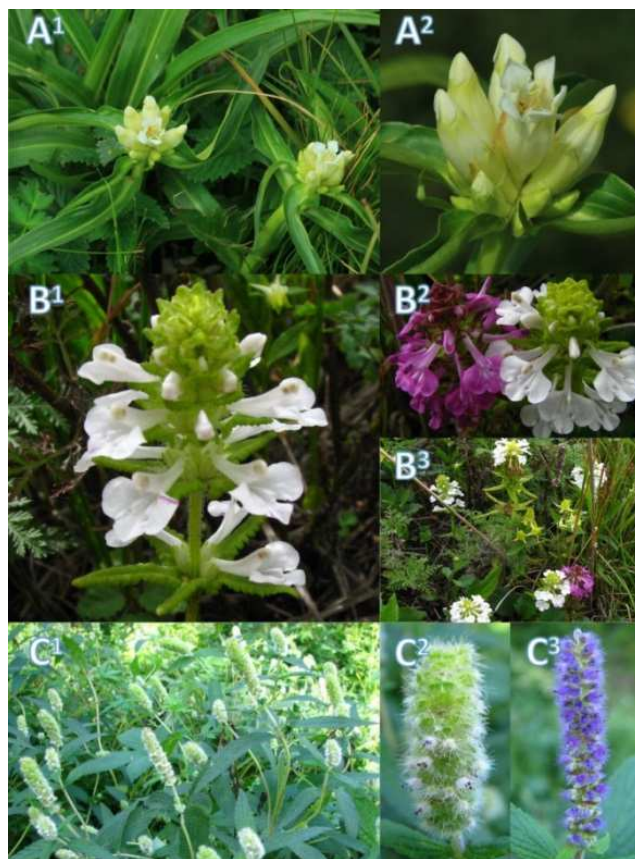


Figure 1. New forms of three plant species with white flowers. A. *Gentiana macrophylla* Pall. f. *alba* G. M. Zhang; B. *Pedicularis spicata* Pall. f. *alba* G. M. Zhang; C. *Elsholtzia densa* Benth. f. *alba* G. M. Zhang and its original form.

2.4. *Aleuritopteris grisea* (Blanford) Panigrahi, Bull. Bot. Surv. India 2: 321. 1961; Fl. China 2–3: 232. 2013. (Figures 2-D, 3)

A small erect fern. Fronds clustered; stipe dark brown, lustrous, with reddish brown and broadly lanceolate scales at base; lamina oblong-lanceolate or ovate-lanceolate, tripinnatifid, abaxially with white farina. Sori born on the edge of pinnules, confluent at maturity. False indusia broad, continuous or somewhat interrupted.

Voucher specimen. CHINA. Beijing: Mentougou District, Baihuashan Nature Reserve, grows in rock crevices, alt. 1700 m, 31 Jul 2017, G. M. Zhang et al. 23 (BJFU).

Distribution and habitat. *Aleuritopteris grisea* is distributed in Bhutan, China, India, Nepal, Pakistan, and Thailand, growing in rock crevices at a high altitude. In China, it is usually found in Guangxi, Guizhou, Hebei, Sichuan, Xizang, and Yunnan, and has now been recorded from Beijing.



Figure 2. Four newly recorded species from Beijing, China. D. *Aleuritopteris grisea* (Blanford) Panigrahi; E. *Polypodium sibiricum* Sipliv.; F. *Androsace incana* Lam.; G. *Sida spinosa* L.

2.5. *Polypodium sibiricum* Sipliv., Novosti Sist. Vyssh. Rast. 11: 329. 1974; Flora of China 2–3: 839. 2013. (Figures 2-E, 3)

A small fern with creeping rhizomes. Fronds remote; lamina oblong-lanceolate in outline, deeply pinnatifid or pinnatisect, glabrous; segments 12–16 pairs, spreading, narrowly lanceolate, 2–2.5 × 0.5–0.6 cm, usually decurrent to

adjacent lobes by narrowly winged rachis, apex obtuse or acute; veins free, veinlets terminating with hydathode near margin. Sori round, without indusia, one line on each side of the midvein, near the edge of the lobes.

Voucher specimen. CHINA. Beijing: Huairou District, Labagoumen Nature Reserve, grows in rock crevices, 40°56.89'N, 116°26.95'E, alt. 1667 m, 31 Jul 2019, G. M. Zhang *et al.* 1923 (BJFU).

Distribution and habitat. *Polypodium sibiricum* is distributed in China, Japan, Korea, Mongolia, Russia, and North America and is usually epiphytic on tree trunks or epilithic. In China, it is found in Heilongjiang, Jilin, Inner Mongolia, and Hebei, and has now been recorded from Beijing.

Taxonomic notes. This taxon has traditionally been identified as *Polypodium virginianum* L. in China, but the latter is confined to eastern North America, whereas *P. sibiricum* occurs from North America to Siberia via Japan and China [10]. The record of *Polypodium pseudoamoenum* Ching (*Polypodiodes chinensis* (Christ) S. G. Lu) from Baihuashan Mountain, Beijing [13] may be a misidentification of *P. sibiricum*.

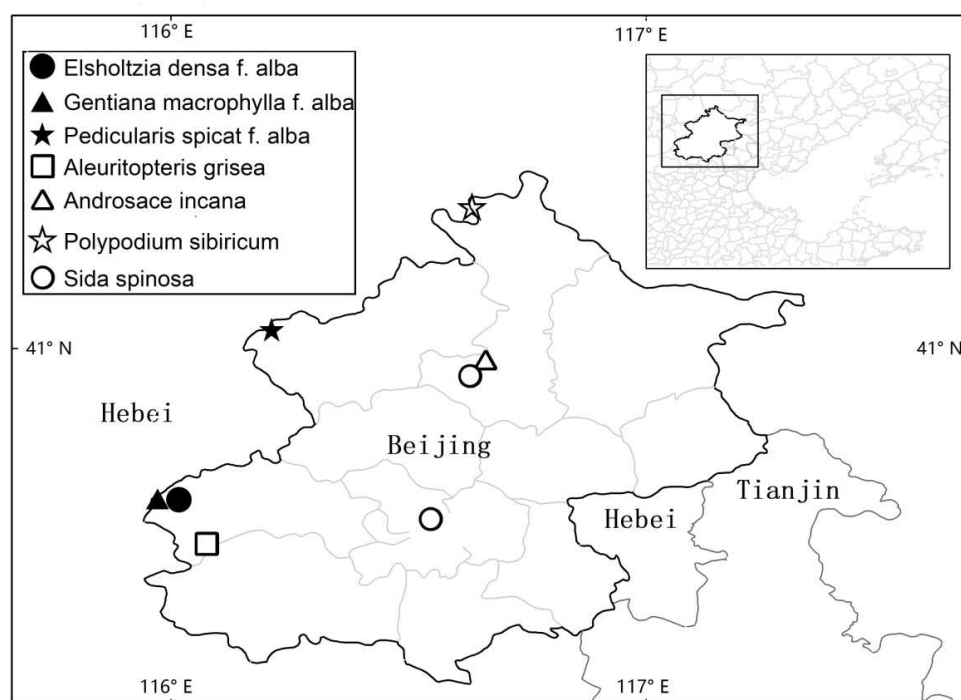


Figure 3. Distribution of *Gentiana macrophylla* f. *alba* (▲), *Pedicularis spicata* f. *alba* (★), *Elsholtzia densa* f. *alba* (●), *Aleuritopteris grisea* (□), *Polypodium sibiricum* (☆), *Androsace incana* (Δ), and *Sida spinosa* (○) in Beijing, China.

2.6. *Androsace incana* Lam., Tabl. Encycl. 1: 432. 1792; Flora of China 15: 100. 1996. (Figures 2-F, 3)

Herbs perennial, small. Leaves sessile, subequal or inner slightly longer than outer, lanceolate to ligulate, 3–9 × 0.8–2 mm, densely long white sericeous. Scapes solitary, with 1–3 flowers at top; bracts lanceolate to broadly linear. Calyx campanulate, ca. 3.5 mm, divided nearly to middle; corolla white or yellowish, 5–8 mm in diam., lobes broadly obovate,

margin entire or obscurely crenate.

Voucher specimen. CHINA. Beijing: Huairou District, Bohai city, grows in rock crevices, 40°27.82'N, 116°29.64'E, alt. 938 m, 6 Aug 2019, W. L. Yang *et al.* 1980 (BJFU).

Distribution and habitat. *Androsace incana* is distributed in China, Kazakhstan, Mongolia, and Russia, typically growing on open grassy slopes. In China, it is found in N Hebei, Nei Mongol, Shanxi, N Xinjiang, and has now been recorded from Beijing.

2.7. *Sida spinosa* L. Sp. Pl. 2: 683–684. 1753. (Figures 2–G, 3)

Subshrubs or herbs, covered with stellate hairs. Stems usually with a spinous protuberance below the node. Leaf blade lanceolate, or narrowly oblong, tomentulose abaxially, with two subulate stipules. Flowers solitary or 2–4 clustered; calyx 5-lobed; petals 5, yellow; staminal column glabrous; style 5-branched. Capsule subconic, hairy; mericarps 5, apex spined. Seeds triangular-obovate, dark brown.

Voucher specimen. CHINA. Beijing: Huairou District, Bohai town, Huaisha River, on river bank, 40°24.87'N, 116°26.68'E, alt. 179 m, 4 Aug 2020, G. M. Zhang et al. 315 (BJFU); Haidian District, Mingguang village, on roadside, alt. 60 m, 25 Sep 2016, Q. R. Liu RQ5810031(BNU).

Distribution and habitat. *Sida spinosa* is widely distributed in both America, Africa, and Asia, and often grows in farmlands, orchards, roadsides, and wastelands. At present, its invasion area in China is expanding, and it has been found in Anhui, Jiangsu, Zhejiang, Jiangxi, Shandong, and other provinces. Although the national standard for “Methods for quarantine and identification of *Sida spinosa*” (GB/T36811-2018) has been published, the research on its life history should be strengthened, and its invasion risk needs to be further evaluated.

3. Conclusion

Three forms of plant species with white flowers are firstly described. Furthermore, four newly recorded species from Beijing are discussed in this paper. This work contributes to our knowledge of the flora of Beijing, China.

Although there are many studies on the flora of Beijing, the plant classification of some special areas is still unsatisfactory. With increased field expeditions, it is certain that more new records will be discovered. In addition, the alien invasive species showed an obvious increasing trend in the past few decades. They may have harmful impacts on the local ecosystem, and should be paid particular attention in the future researches.

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