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Saussurea luae (Compositae, Cardueae), a new species of Snow Lotus from China

Abstract

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A species of *Saussurea* from the *S. obvallata* group is described as new to science and illustrated. It occurs in the central and eastern part of the Qinghai-Tibetan Plateau in western China, in the high alpine zone above 4000 m altitude. First chromosome counts for the species resulted in $2n = 32$. All previous Chinese records of *S. conica*, a distinct taxon so far actually known only from Sikkim and Bhutan, can be attributed to the new species.

Additional key words: Asteraceae, *Saussurea* subg. *Amphilaena*, *Saussurea conica*, chromosome numbers, Hengduan Shan, Qinghai-Tibetan Plateau

Introduction

Saussurea DC. is one of the largest genera of Compositae in China, and one of the species-richest groups of vascular plants on the Qinghai-Tibetan plateau. According to Shih & Jin (1999), 264 species of *Saussureas* s.l. occur in China; only seven of them are to be attributed now to other genera, following the molecular and morphological studies by Raab-Straube (2003) and Kita & al. (2004). The highest diversity of *Saussurea* is found in the Hengduan Shan (101 species, Wang 1994), the easternmost part of the Qinghai-Tibetan Plateau, which is one of the botanically richest areas in China. *Saussurea* species live in a wide range of subalpine and alpine habitats, from the subalpine forests up to the nival zone, many of them regularly exceeding 5000 m above sea level. The *S. obvallata* group, congruent to *Saussurea* subg. *Amphilaena* (Stscheckl.) Lipsch., is predominantly distributed in the highest mountain regions of Asia, from the Karakorum and the Himalaya to the Tian Shan, the Altai, across the Qinghai-Tibetan plateau to the Hengduan Shan and reaching with a few species the central and eastern Chinese mountains from the Yangtze gorges to the surroundings of Beijing. About 25 species can currently be accepted in this group, with 22 of them present in China. Molecular studies could not confirm monophyly of *Saussurea* subg. *Amphilaena*, due to low

resolution in the cladograms at species level (Raab-Straube 2003; Kita & al. 2004). Morphologically, the group is chiefly characterized by its yellowish, reddish or whitish coloured bracts, which subtend or surround the whole synflorescence. In the most prominent species, such as *S. obvallata* (DC.) Sch. Bip. and *S. involucrata* Kar. & Kir., the large semitransparent yellowish bracts enclose the synflorescence, which gives those plants a similar appearance like lotus flowers in bud; hence the common name Snow Lotus.

During a plant collecting expedition to the Hengduan Shan, we encountered near Daofu in northwestern Sichuan a population of *Saussurea* with large, coloured bracts, which at first sight could not be assigned to any known species. Later on the same trip, we found similar plants again on Chola Shan. Subsequent herbarium studies have shown that this species has been collected before from more localities, but in spite of its striking appearance, it has always been misidentified, often as "*S. conica* C. B. Clarke". Comparison with the type material of all members of the *S. obvallata* group has shown that these plants cannot be attributed to any known species. Therefore, it is necessary to describe this taxon here as new to science.

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Fig. 1. *Saussurea luae* – holotype specimen (Raab-Straube, Smalla & Sun 1134, B 100185595).

Material and methods

Living plants were observed in the wild on a collecting trip to NW Sichuan, China, in two distant populations. The description of the new species is based on these observations and on herbarium material collected by the author as well as on herbarium sheets on loan. As part of a taxonomic revision of the *Saussurea obvallata* group, a large number of specimens from many herbaria was studied for comparison. The type specimens of all species in *S.* subg. *Amphilaena* were directly examined.

For cytological analyses, root tips from potted plants raised in the Botanic Garden Berlin-Dahlem from fruits collected in the wild (*Raab-Straube, Smalla & Sun 1184*, B) were harvested in the early morning. They were pretreated for c. 4 h at 5–8 °C with 0.002 M aqueous solution of 8-hydroxyquinolin and then fixed in ethanol-acetic acid (3 : 1). The material was hydrolysed with 1N hydrochloric acid at 60 °C for 10 min, stained with aceto-orcein on a slide, shortly heated, squashed and analysed under a microscope.

Saussurea luae Raab-Straube, **sp. nov.** 宝璐雪莲 – bao lu xue lian – Fig. 1-2

Holotype: China, Sichuan, Dawu [Daofu] Xian, Da Xue-shan, pass 10 km NE of Dawu [Daofu] on road to Barkam [Ma'erkang], open herbaceous vegetation near mountain stream, E-exposed slope, among boulders on acid rock, 4350 m, 31°02'10"N, 101°13'01"E, 23.9. 2000, *E. v. Raab-Straube, M. Smalla & Sun Hang 1134* (B 100185595; isotypes: A, BM, CAS, E, HNWP, K, KUN, MO, P, PE).

– *Saussurea conica* 肿柄雪莲 – zhong bing xue lian sensu Liu (1985: 869) and Shi & Jin (1999: 29), non C. B. Clarke, *Compos. Ind.*: 224. 1876

Saussureae globosae F. H. Chen similis; sed caudice crasso multiceps, caespitibus densis multicaulibus formantibus; bracteis flavidis vel flavo-roseis, dentatis (nec intense purpureis, minute denticulatis vel integris); acheniis distincte costatis ed coronulatis (nec laevis, ecoronulatis); pappo roseo-violaceo (nec albo-stramineo) bene differt.

Perennial herb, 30–70 cm high, densely tufted, forming large clumps with many flowering stems together with sterile leaf rosettes. *Rootstock* stout, woody, much branched, apically densely covered with dark brown remains of old leaf sheaths. *Indumentum* of up to 2 mm long, uniseriate, colourless, eglandular hairs consisting of few ± isodiametric basal cells and one elongated terminal cell, and of up to 0.5 mm long stalked, biseriate, golden-yellow glandular hairs. *Flowering stems* 4–6 mm in diameter near base, erect, basally densely covered with dark brown, persistent remains of old leaf sheaths, regularly leafy with 5–10 leaves, shallowly sulcate, straw-coloured and tinged purple, apically sparsely to

densely appressed-pilose, basally glabrescent or glabrous. *Leaves* aromatic, concolorous, green, adaxially sparsely pilose or glabrescent, abaxially densely golden-glandular and sometimes with isolated eglandular hairs; apex acute; margin irregularly sinuate-dentate; *rosette leaves* petiolate, narrowly elliptic to linear, blade 10–35 × 0.6–3.2 cm; base tapering into a 5–14 cm long, pale straw-coloured, basally widened petiole; *basal and lower cauline leaves* shortly petiolate, narrowly elliptic to linear, 11–23 × 1–3 cm; base tapering into a 2–5 cm long, sheathing petiole; *middle and upper cauline leaves* sessile, narrowly elliptic or narrowly ovate to ovate, gradually merging into bracts, 7.5–14 × 1.4–2.8 cm; base semiamplexicaul, slightly decurrent. *Bracts* sessile, membranaceous, pale greenish yellow, or yellowish green tinged purple, adaxially sparsely pilose, abaxially densely glandular, ovate, cymbiform, 1.7–8 × 0.7–3.2 cm; apex acute or acuminate; margin irregularly dentate; base semiamplexicaul, decurrent; the larger lower ones subtending and half-enclosing the synflorescence. *Peduncles* (0.5–)1–9(–13.5) cm, mostly purple, sulcate, obtusely four-angled, appressed-villous to patently villous, widened to 5–7 mm below the capitula. *Capitula* (1–)2–6(–8), arranged in a lax, corymbose synflorescence or sometimes solitary at the end of the stem, with up to 90 florets. *Involucre* broadly campanulate, 1.5–2.5 cm in diameter. *Receptacle* slightly convex, densely bristly; *receptacular bristles* subulate, 3.8–7.5 × c. 0.1 mm, glabrous, shiny straw-coloured, acute. *Involucral bracts* spirally arranged in 5–6 rows, imbricate, adaxially shiny brown to straw-coloured with dark brown margin, glabrous, villous only near apex, abaxially sericeous-villous, later glabrescent, ovate-triangular to linear; apex acute; margin minutely denticulate; *outer involucral bracts* triangular-ovate, abaxially dark blackish or purplish brown, densely villous, 7.1–8 × 2.2–3.5 mm; *middle involucral bracts* narrowly ovate, basally yellowish stramineous and glabrous, apically dark brown or purplish and villous, 8.3–13 × 1.7–2.5 mm; *inner involucral bracts* narrowly elliptic to linear, yellowish stramineous and glabrous in basal and median part, dark brown or purplish and villous near apex, 13.4–15.2 × 0.8–1.9 mm. *Corolla* purple, glabrous, actinomorphic to slightly zygomorphic (length difference between two incisions of adjacent corolla lobes 0.2–0.6 mm), 11–16.5 mm; tube 5.8–8.7 × 0.4–0.6 mm; throat 2–3 × 1–1.2 mm; lobes linear with rounded tips, 3.2–4.4 × 0.4–0.5 mm. *Stamina* 6–8 mm; filaments 1.8–3 mm; anther tube purple, (4.5–)6–8 mm including appendages, fertile part 3.5–5 mm, apical appendages 1–1.5 mm, basal appendages 2–3 mm, laciniate in many unicellular hairs. *Style* 12–15 mm; style branches diverging, 1.2–2.2 mm. *Achenes* cylindrical, obovoid or obconic, the central ones straight, the outer ones slightly curved, 4–5.7 × 1.5–2 mm, brown to blackish brown, with 5–7 distinct ribs; apex with conspicuous denticulate crown; base truncate. *Pappus* heteromorphic, biseriate, rose-purple (bristles dirty white-yellowish

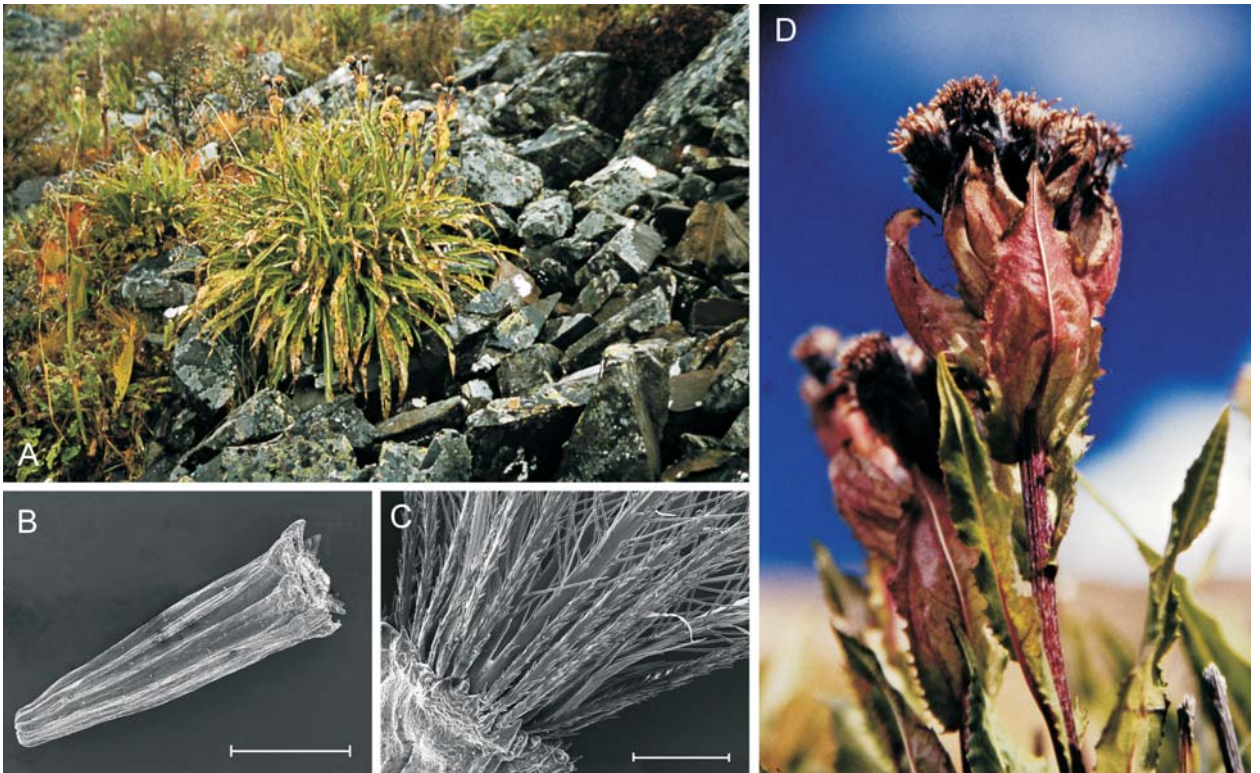


Fig. 2. *Saussurea luae* – A: plant in boulder scree, photograph from the type locality, 23.9.2000; B: synflorescence, photograph from Chola [Qu'er] Shan pass, 4750 m, 26.9.2000; C: scanning electron micrograph of achene; D: scanning electron micrograph of achene crown and pappus base. – Scale bars: C = 2 mm, D = 0.6 mm; C-D from the type collections.

with purple inclusions); outer bristles numerous (c. 25), 1.8–3.3 mm, straight, terete, scabrid with c. 0.1 mm long teeth, falling off individually; inner bristles 14–16, 9–11 mm, curved outwards, dorsiventrally flattened, plumose with up to 1.7 mm long fimbriae, connate at base to a ring, falling off as a whole. *Flowering* August to September; *fruiting* September to October.

Ic. — Fig. 1–2; Liu 1985: t. 372, fig. 2 (as *Saussurea conica* C. B. Clarke). Good colour pictures of the plants in bud from the Seqi La locality in S Tibet can also be found on the Hengduan Mountains website (Boufford & al. 2005+).

Variability. — The colour of the bracts varies between greenish yellow without any rose or purple (most plants from the type locality) to yellowish green and intensely tinged with purple (plants from S Tibet), but they are never entirely purple like in *Saussurea globosa*. The colour of the achenes is variable during development, they are brown when immature and become almost black with straw-coloured ribs when fully ripe; brown fruits with dark ribs have also been observed. The pappus colour is quite a constant character, however, single pappus elements may lack the purple inclusions and sometimes the colour cannot be reliably determined in herbarium specimens. Young plants with only one flowering stem are occasionally found, but most plants within the examined populations were fully developed,

forming large tufts with many flowering stems (this important character can often not be seen in herbarium specimens). There is also slight variation in indumentum density, stem colour (\pm tinged purple) and size of the floral elements, but overall, the specimens seen from five very distant populations are remarkably uniform.

Chromosome number. — Examination of material from Chola Shan (W Sichuan, China) resulted in $2n = 32$. It is a diploid species with the base number $x = 16$ like most other species of *Saussurea* sect. *Amphilaena* so far examined cytologically (*S. bracteata* Decne.: Vir Jee & al. 1984, 1989; *S. globosa* F. H. Chen: Fujikawa & al. 2004; *S. involucrata* (Kar. & Kir.) Sch. Bip.: Ma & al. 1984; *S. obvallata* (DC.) Sch. Bip.: Gupta & al. 1989, Amano & Ohba 2000; Fujikawa & al. 2004; *S. orgaadayi* Khanm. & Krasnob.: Khanminchun & Krasnoborov 1984; *S. uniflora* (DC.) Sch. Bip.: Amano & Ohba 2000). This number is relatively rare in the genus as a whole, where $x = 13$ with diploid, triploid, tetraploid and hexaploid species is by far the commonest, mainly in *S.* sect. *Saussurea* (see review by Fujikawa & Ohba 2003). This result corroborates a close relationship of *S. luae* with other members of *S.* subg. *Amphilaena*.

Eponymy. — The species name is dedicated to Pan Lu 潘璐 from Kaifeng, China, with love. I also propose to use the new Chinese name “bao lu xue lian” 宝璐雪莲

for this species, meaning “precious jade snow lotus”. The Chinese character for precious jade, “lu” 璩, was first used in a poem by Qu Yuan (340-278 b.c.e.).

Distribution. — The species is known so far only from five localities (Fig. 3), four of them several hundred kilometres distant from each other, three in C and SE Tibet and two in NW Sichuan. Since this vast region has been botanically explored nearly exclusively along the main roads, and *Saussurea luae* was found on most of the important passes of an altitude above 4000 m, its area is probably not disjunct and presumably larger than the presently known locations indicate. Records from Lhünzhub Xian and Nang Xian (Liu 1985; Shih & Jin 1999) probably refer to the specimens in HNWP, KUN and PE from Lhasa and from Nyingchi, respectively (the pass Seqi La is on the border between Nang and Nyingchi).

Habitat. — *Saussurea luae* occurs at high altitudes between 4000 and 5000 m above sea level. It grows on open gravelly and rocky slopes, often with stabilized boulder scree, and in ravine beds, where moisture remains in the ground even in late summer. It has been found together with grasses, herbs and tall forbs in alpine meadows and open dwarf shrub communities with *Salix* and *Rhododendron*, sometimes just near the tree line of *Juniperus* forests in S Tibet. The species apparently prefers more open vegetation communities to closed meadows, and it is often colonizing bare boulder fields. So far it has only been found on granite bedrock.

Additional specimens seen. — CHINA: XIZANG (TIBET): LHASA (LASA) SHI: Ximala Shan, 5000 m, 20.8.1965, *Lang Kai-yong & Zhang Yong-tian 2130* (KUN 729990, PE 883660, 883661, 883662); hills north of Lhasa, 15000 ft, [29°47'N, 91°11'E], 17.8.1942, *F. Ludlow & G. Sherriff 9009* (BM 535125, E 47925, UPS 200020). — NYINGCHI (LINZHI) XIAN: Be-

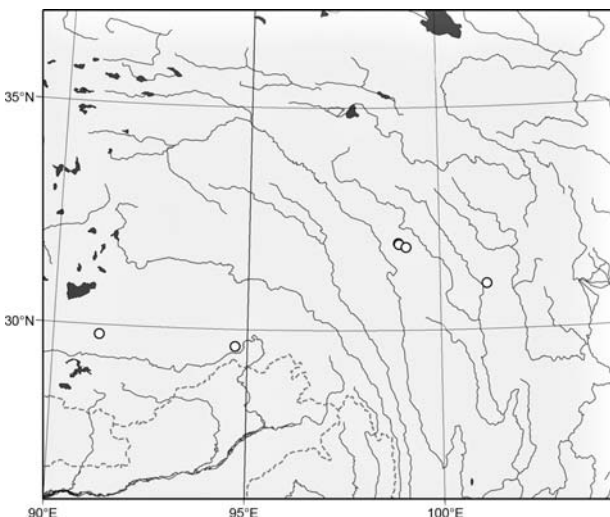


Fig. 3. Geographical distribution of *Saussurea luae* (○).

tween the cities of Linzhi (Nyingchi) and Bomi (Pome) on highway 318, Seji (Serkyim) La (pass), 4500-4600 m, 29°36'40"N, 94°39'6"E, 17.8.2000, *D. E. Boufford & al. 30123* (A [HUH 236910], B 100344176); Gyala Peri W, upper Bong Chu, E of pass Nyingchi-Dongjuk, 4400 m, 29°37'N, 94°41'E, 26.8.1994, *B. Dickoré 11805* (B, MSB); Seqi La pass, 4450 m, [29°37'N, 94°41'E], 17.9.1980, *Ecol. Dep. Plateau Team 15642* (PE [3 sheets]); western side of Seqi La pass, 2.8.1975, *First Additional Qinghai-Xizang Exped. Team 75-1043* (HNWP 51662, PE 1101555, 1101556, KUN 729842, 729843); southern side of Seqi La Shan, 4400 m, 17.9.1980, *Ni Zhi-cheng & al. 1718* (PE). — SICHUAN: DÊGÊ (DEGE) XIAN: Chola Shan, Chola [Que'er] Shan pass 27 km W of Maniganggo on main road to Dêgê, 4750 m, 31°56'48"N, 98°54'44"E, 25.9.2000, *E. v. Raab-Straube & al. 1182* (B, KUN); *ibid.*, 26.9.2000, *E. v. Raab-Straube & al. 1184* (B, KUN); road (highway 317) from Dêgê to Manigange on W side of Chola Pass over Que'er Shan, 4310 m, 31°57'11"N, 98°54'13"E, 16.8.2006, *D. E. Boufford & al. 36600* (A, B 100273711); *ibid.*, 31°56'47"N, 98°54'45"E, *D. E. Boufford & al. 36614* (A, B 100273709); Chola Shan pass, 4550-4700 m, 31°56'N, 98°56'E, 23.9.1994, *G. & S. Miehe 94-385-1* (B, herb. Miehe); upper Yalong basin, Chola Shan, Dêgê - Garzê, Manigango, 4100-4500 m, 31°52'N, 99°7'E, 26.9.1994, *G. & S. Miehe, U. Wündisch 94-424-6* (herb. Miehe); *ibid.*, 4050-4200 m, 27.9.1994, *G. & S. Miehe, U. Wündisch 94-444-2* (herb. Miehe).

Taxonomic remarks. — The coloured bracts subtending the synflorescence and enclosing it when young clearly make *Saussurea luae* a member of the *S. obvallata* group. Morphologically, *S. luae* is closest to the variable *S. globosa* F. H. Chen, which is very widespread in the Hengduan Shan in Sichuan, but becomes rare to the west and is absent on the central part of the Qinghai-Tibetan plateau. *S. globosa*, however, never forms large clumps, its stems always arise solitary from a much smaller rootstock, its bracts are always intensely purple, entire or minutely denticulate, its heads are smaller and globose, the achenes are smooth and ecoronulate and the pappus is always dirty-white. At the type locality, *S. globosa* grows together with *S. luae*. After careful examination of a large part of the population, no obvious signs of hybridization between the two species could be detected. At the Chola Shan locality, the population of *S. luae* grows close to *S. obvallata*; also no hybrids were noted there. From *S. obvallata*, the new species differs quite obviously in growth form, leaf shape, bract size, synflorescence shape and involucre characters. *S. luae* has sometimes been confused with *S. conica* C. B. Clarke, which was described from the Sikkim Himalaya (Clarke 1876). Soon after its description, it was suggested that this species was conspecific with *S. uniflora* (Wall. ex DC.) Sch. Bip., only differing in the number of heads (Hooker 1881), and consequently reduced to a variety of the latter. Subsequent workers followed Hooker's con-

cept (Lipschitz 1979; Grierson & Springate 2001). Using the Latin key in the only monograph available (Lipschitz 1979), the present species would be determined as *S. uniflora* var. *conica* (C. B. Clarke) Hook. f. The keys by Liu (1985) and Shih & Jin (1999) also would lead to *S. conica*, treated there as a separate species. The descriptions and figures in these works, prepared from Chinese material, match well the present taxon, but differ from the syntype specimens of *S. conica* from Sikkim (*Clarke 12541, 12586, 26174* [K 000250083!, K 000250084! K 000250085!]) and additional specimens from Sikkim and Bhutan. *S. uniflora* var. *conica* differs from *S. luae* by its elliptic, ovate or obovate, much wider (3-5[-6] cm) and shorter (10- 15[-20] cm) cauline leaves, intensely purple, entire or minutely denticulate bracts, smooth, ecoronulate achenes and a dirty white pappus. As the growth form of *S. uniflora* var. *conica* is not exactly known, it is not clear if both taxa also differ in this character or not. Most herbarium specimens of *S. uniflora* var. *conica* have single stems, and there are no label annotations indicating the formation of large clumps as in *S. luae*. They certainly have rootstocks with at least one or two flowering stems and sterile leaf rosettes. For the time being, no record of *S. uniflora* var. *conica* from China is known, but it may well be found in S Tibet, close to its area in the bordering countries. The combination of the most characteristic features in *S. luae*, growth form, leaf shape, pale, dentate bracts, coronulate, ribbed achenes and constant rose-purple pappus, has not been found in any other species of the *S. obvallata* group.

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