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# Review of Chinese *Spiraea* (Rosaceae, Spiraeoideae) with Simple Inflorescences

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**ABSTRACT.** Several morphotypes of simple inflorescences occurring in the genus *Spiraea* L. (Rosaceae), widely used for classification and determination, but not uniformly interpreted in the literature, are correctly defined. Taxonomically, *S. compsophylla* Hand.-Mazz. is synonymized with the imperfectly known *S. calcicola* W. W. Sm., whose amplified description and illustration are added. A newly distinguished species, hitherto confused with the former name, is described from Yunnan Province in China and illustrated as *S. adiantoides* Businský, with its assignment to section *Glomeratae* Nakai. Two imperfectly known and confused species of *Spiraea* sect. *Chamaedryon* Ser. from Taiwan, *S. tarokoensis* Hayata and *S. tatakaensis* I. S. Chen, are carefully described, illustrated, and compared with six similar Chinese species. A new variety, *S. lasiocarpa* var. *villosa* Businský, is described from western Sichuan Province, accepting the concept that *S. lasiocarpa* Kar. & Kir., described from today's eastern Kazakhstan and hitherto neglected in Chinese floras, is the correct name for the Chinese taxon *S. mongolica* Maxim. Two imperfectly known taxa from southwestern Sichuan, *S. muliensis* T. T. Yu & L. T. Lu and *S. daochengensis* L. T. Lu, were found to be conspecific after comparison of their respective holotypes and a newly found population; the former is accepted as the correct name. *Spiraea sericea* Turcz. is accepted only at the rank of the variety as *S. media* Schmidt var. *sericea* (Turcz.) Maxim. A key to the Chinese species of *Spiraea* with simple inflorescences is newly compiled, encompassing 40 species.

**Key words:** China, IUCN Red List, Rosaceae, *Spiraea*.

Seventy species of the genus *Spiraea* L. (Rosaceae, Spiraeoideae) have recently been reported from China, including Taiwan, in the *Flora of China* treatment (Lu & Crinan, 2003). However, certain oversights exist in the treatment of this taxonomically critical genus. These concern certain characters in some imperfectly known species, as well as the wording used in certain group leads in the key to species. As a result of a field study, two species pairs

with simple inflorescences from Yunnan and Taiwan that had been hitherto confused are newly distinguished here. One species from each pair is found either as a new species or as one neglected for the Chinese flora. Inflorescence type has traditionally been the most important character used to classify the genus *Spiraea*, but a certain confusion in its interpretation exists. Two principal inflorescence types are found in this genus, distinguished as those with 1-flowered pedicels (simple inflorescences) or those with branched pedicels (compound inflorescences). Both types are of indeterminate (racemose) character, i.e., the lower flowers (for compound inflorescences, those of each segment) open first. Although these two inflorescence types discriminated infrageneric division within the genus (for the history of its classification, see Businský & Businská, 2002), recent molecular analyses (Potter et al., 2007) reveal that neither inflorescence type is monophyletic. Maximowicz (1879: 173), in his comprehensive classification of the genus, concisely defined inflorescences of true spiraeas as “flores haud vere racemosi, pedicellis inaequilongis.” He indicated the simple type as “corymbi vel fasciculi pedicellis 1-floris” and the compound type as “corymbi vel paniculae compositae.” Schneider (1905: 449, 450, 454) described inflorescences of the subgenus *Euspiraea* C. K. Schneid. (the genus *Spiraea* by today's concept) in German as “± scheindoldig, einfach doldentraubig oder ± zymös verästelt, nie deutlich gestreckte Trauben.” He divided the simple type into one group with “Blütenstand doldig, sitzend” and another group with “Blütenstand stets ± doldentraubig, gestielt.” Rehder (1927: 333, 1940: 328) indicated the simple types similarly as “sessile umbels” and “umbel-like racemes on leafy branchlets.” Of these three cited authors, Maximowicz's definition is the most accurate. The simple inflorescence type found in *Spiraea* is always determined by its lateral position on the previous year's shoots. They differ only in the length of the inflorescence axis, the continuing peduncle, and short branchlet. This length difference can be understood as an increase (in agreement with most

old classifications, e.g., Maximowicz, 1879; Zabel, 1893; Schneider, 1905; Rehder, 1927, 1940) or a decrease (in agreement with the concept founded by Nakai, 1916; modified by Pojarkova, 1939, and Yu & Kuan, 1963; and used in Chinese floras: Yu & Lu, 1974; Lu & Crinan, 2003; i.e., probably in agreement with evolutionary trend). These morphotypes can be divided and taxonomically applied in the following way: (1) sessile flower fascicles (arising from lateral winter buds) appearing as nonstalked umbels, with a basal leaf rosette; (2) shortly pedunculate (subsessile), congested corymbs, with a basal leaf rosette; (3) corymbs or racemose (elongated) corymbs on a peduncle that continues as a leafy short branchlet; and (4) seeming umbels on a peduncle that continues as a leafy short branchlet. The first and second morphotypes have been traditionally classified as *Spiraea* sect. *Glomeratae* Nakai, the latter two as *Spiraea* sect. *Chamaedryon* Ser. in a narrower concept (Yu & Kuan, 1963; Yu & Lu, 1974; Businský & Businská, 2002). The term umbel-like or umbellate raceme used by several authors is equivocal and can be understood as a simple corymb, i.e., an intermediate form between raceme and umbel (as used in the key and elsewhere in the *Flora of China* treatment by Lu & Crinan, 2003, in contrast to umbel), or as the collective term for simple corymb and umbel (Rehder, 1927, 1940). Maxwell and Knees (1995) used the term corymb for sessile flower fascicles and seeming umbels, or for the true (simple) and also compound corymbs (they usually did not use the designation as compound). They alternatively also used the term raceme, but only for *S. media* Schmidt. The seemingly umbellate morphotype found in the genus *Spiraea* is only an approximate analogy, where the pedicels are  $\pm$  equally long and densely crowded together, but they do not arise strictly from the same point. A few isolated flowers on a similarly long pedicel as shifted down on the peduncle may also often occur. The racemose corymb, as a variant of simple corymbs within the above-mentioned third morphotype, is an intermediate form between raceme and corymb, and can be defined as an elongated corymb with the lower pedicels only indistinctly longer than upper ones. Racemose corymbs typically occur, for instance, in *S. media*.

Together with my wife, Ludmila Businská, we carried out a series of research expeditions to China, where all taxa of the genus *Spiraea* that we found in nature were sampled (Businský & Businská, 2002: 11). In addition to these cited specimens, most *Spiraea* collections at PE and KUN were also examined.

#### TWO TAXONOMICALLY CONFUSED SPECIES OF *SPIRAEA* FROM NORTHERN YUNNAN

Two similar taxa of the genus *Spiraea* with simple umbel-like, subsessile, lateral inflorescences on the previous year's shoots and heteromorphic leaves were described from northwestern Yunnan under the names *S. calcicola* W. W. Sm. and *S. compsophylla* Hand.-Mazz. The former was described (Smith, 1913) from an elevation of ca. 3500 m from Yulongxue Shan north-northwest of Lijiang. The latter name was described (Handel-Mazzetti, 1933) based on the author's own material from 3200 m in the mountains situated to the southeast above what is today Luoji at the eastern margin of Zhongdian Xian near the Sichuan border. Although these localities are found today in different prefectures (Lijiang and Diqing, respectively), they are situated only 70 km from one another. Yu and Kuan (1963) listed both taxa separately as members of *Spiraea* (sect. *Glomeratae*) ser. *Hypericifoliae* Pojark. ex T. T. Yu. Both taxa were also treated as separate species in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003), and the same relevant illustration of both was given in one plate in both publications (Yu & Lu, 1974: 61, t. 8; Wu & Raven, 2004: 34). Beyond the various leaf shapes and fruits discussed for both taxa, the plate in question contained a flowering branchlet of *S. calcicola* and a fruit-bearing branchlet of *S. compsophylla*, which are hardly comparable. Both taxa were also accepted separately in the *Index Florae Yunnanensis* (Institutum Botanicum Kunmingense Academiae Sinicae, 1984: 542), with *S. calcicola* given from between 2700 and 3600 m elevation, and *S. compsophylla* from between 2000 and 4000 m. Detailed study of the type material for both *S. calcicola* and *S. compsophylla* revealed both taxa perfectly conspecific, characterized principally by the distinctly angled, dark brown shoots and branchlets. By nomenclatural priority, Handel-Mazzetti's name synonymizes to Smith's older one.

***Spiraea calcicola*** W. W. Sm., Notes Roy. Bot. Gard. Edinburgh 8: 131. 1913. TYPE: China. Yunnan: [Lijiang Xian], crevices of dry limestone cliffs on the eastern flank of the Lichiang Range [Yulongxue Shan], 27°20'N [27°10'N], 11,000–12,000 ft., June 1910, G. Forrest 5730 (holotype, E not seen; isotype, PE). Figure 1.

*Spiraea compsophylla* Hand.-Mazz., Symb. Sin. 7: 450, pl. 13, fig. 1. 1933, syn. nov. TYPE: China. Yunnan: "Inter pagos Yungning und Dschungdien (Chungtien) [Zhongdian], in regionis temperatae rupibus aridis montis Lamatso. Substr. Calceo, ca. 3200 m," 12 July 1915, Handel-Mazzetti 7608 (holotype, W).

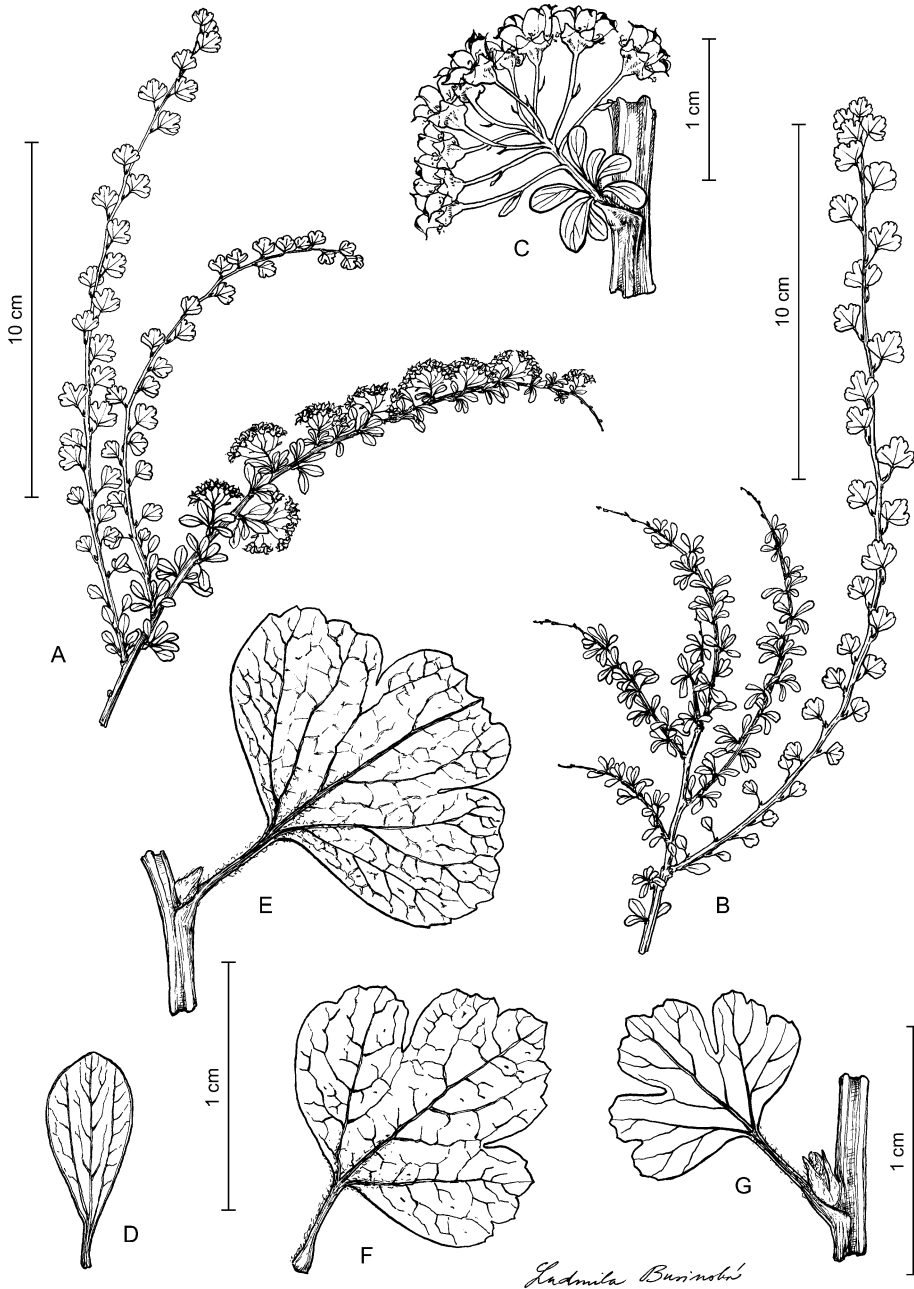


Figure 1. *Spiraea calcicola* W. W. Sm. —A. Fertile branch with two young long shoots. —B. Three-year portion of sterile branch with one young long shoot. —C. Inflorescence in fruit with basal leaf rosette. —D. Leaf from inflorescence basal rosette, abaxial view. —E, F. Fully developed leaves of sterile long shoots, abaxial view. —G. Fully developed leaf of sterile long shoot, adaxial view. Drawn by Ludmila Businská from July collection, *R. Businský 30409* (G), at the type locality.

Shrubs to 1–1.5 m tall, densely branched, with longer branches  $\pm$  arcuate, angled, grayish dark brown from second year; sterile long shoots of the present year (fully developed only from July) to ca. 25(–40) cm, usually arcuate, dark reddish brown, conspicuously angled with irregular ridges and grooves, sparsely

pubescent to glabrescent, not cracking or peeling in the following year; buds elongate-conical, usually shorter or equal to half of petiole, with several sparsely pilose scales. Leaves deep green adaxially, grayish green and not papillose abaxially, with margin somewhat thickened, not revolute; venation reticulate, deep green,

contrasting abaxially; leaf blades, as reduced in basal part of sterile long shoots, often slightly longer than wide, broadly angular-obovate and  $\pm$  narrowly cuneate; blades fully developed in middle and apical portions of shoots, wider than long, transversally rounded rhombic and broadly cuneate or truncate to subcordate at base, (5–)7–10(–12)  $\times$  (6–)8–14(–16) mm, 3-lobed or rarely 5-lobed, with notches shallow to more than half deep, all lobes  $\pm$  truncate or middle lobe broadly triangular, in front irregularly crenulate, crenate, or coarsely and obtusely dentate but with the apical tooth often pointed; initially very sparsely pilose to almost glabrous  $\pm$  equally on both surfaces, more pilose only on base of principal veins abaxially; venation consists of three principal veins branching at one point at the triangular basal connection to petiole; petioles (2–)3–5(–6) mm,  $\pm$  sparsely pilose, with basal lateral edges decurrent into longitudinal shoot ridges, basal part persists after shedding the leaves; leaf blades of lateral rosettes at the inflorescence base and on lateral shortest sterile branchlets of older twigs entire, obovate, with narrowly cuneate base and rounded apex, (2.5–)4–7(–9)  $\times$  (1.5–)2.5–3.5(–4.5) mm, glabrous on both surfaces, 3-veined; petiole to ca. 2 mm. Inflorescences densely arranged, usually 10 to 30, set laterally on arcuate branches (changed from previous year's long shoots), each with basal leaf rosette; basically shortly pedunculate corymbs, on less vigorous branchlets congested, sessile and therefore of umbel-like form, on lower flowering portion of more vigorous branchlets with the peduncle to ca. 12 mm, with distant pedicels; corymbs with (6)7 to 12(to 26) flowers on firm, glabrous, unbranched pedicel usually with narrow bract, rarely some lower pedicels branched, with several flowers. Hypanthium campanulate, thickly walled, firm and fragile when dry, externally entirely glabrous, smooth, light brown, inside with usually sparse, long hairs, ca. 2.5 mm diam. in fruit; sepals triangular, 0.7–1.4  $\times$  1–1.6 mm, externally glabrous, inside finely pubescent or glabrescent, erect-spreading in fruit. Follicles erect-spreading to erect, sparsely hairy only along ventral suture or entirely glabrous, with erect-spreading styles.

*Habitat and distribution.* *Spiraea calcicola* occurs on rather sunny limestone, rocky, or scree substrates between 2700 and 4000 m, often under sparse pine stands of *Pinus densata* Mast. or *P. armandii* Franch. This taxon is known only from northwestern and northeastern Yunnan, China.

*IUCN Red List category.* Least Concern (LC; IUCN, 2001).

*Notes.* The protologue of *Spiraea calcicola* (Smith, 1913) and its subsequent description in the

*Flora of China* treatment (Lu & Crinan, 2003: 72) above all did not consider the sterile long shoots, especially their specific leaf morphology. These are described only in Handel-Mazzetti's Latin protologue (1933) for the synonymous *S. compsophylla* based on the only specimen cited. A more complete description and a new illustration are therefore given here, based on additional specimens examined and from a study of the species at two localities. However, both visits were during fruiting season, and therefore flowers in blossom are not described, but expected to be in May or June.

During our first expedition to Yunnan in 1990, we found and also collected *Spiraea calcicola* in the region of its type locality on Yulongxue Shan, and the second entity, represented to date by the name *S. compsophylla*, at its oldest documented locality near Qiaotou from 1939. We also found the former species in 1998 at a new locality in the northeastern corner of Yunnan (near the Sichuan border) on Yao Shan (Qiaojia Xian).

*Selected specimens.* CHINA. **Yunnan:** Zhongdian Xian, N flank of Haba Snow Range, *K. M. Feng 1257* (KUN, PE); Likiang [Lijiang] Xian, Likiang Snow Range, *Zang 8938* (KUN, PE); Zhongdian Xian, Sanqi Xiang, ?*Shen 21035* (KUN, PE); Lijiang Pref. & Xian, Yulongxue Shan, E foot above rd. from Lijiang to Daju, in valley ca. 2 km W of Heishui, *R. Businský 30409* (G, Silva Tarouca Research Institute for Landscape and Ornamental Gardening [RILOG] herbarium); Zhaotong Pref., Qiaojia Xian, Yao Shan, upper NW slopes of great steep rocky amphitheatre above Kangjiahe, *R. Businský 46405* (G, RILOG herbarium).

The following undescribed species is discriminated here from material of the misinterpreted *Spiraea compsophylla* and is presented below as a new species.

***Spiraea adiantoides*** Businský, sp. nov. TYPE: China. Yunnan: Diqing Pref., Zhongdian Xian, S foot of Habaxue Shan, Hutiaoxia (Tiger Leap Gorge), Jinsha Jiang (Yangtze river) valley ca. 4 km ENE from mouth of Xiaozhongdian He at Hutiaoxiazhen (Qiaotou), fissures of almost vertical rocks of crystalline limestone, 1950 m, 27°11'N, 100°06'E, 12 July 1990, *R. Businský 30403* (holotype, G; isotypes, MO, RILOG herbarium). Figure 2.

Haec species inter congeneros sinenses ad *Spiraeam* sect. *Glomeratas* Nakai pertinentes quoad ramos elongatos sicut ramulos teretes primo pallide brunneos atque folia heteromorpha utrinque glabra *Spiraeae kwangsiensis* T. T. Yu simillima, sed ab ea ramis elongatis omnino glabris atque ramorum elongatorum sterilium laminis foliariis late angulari-obovatis usque transverse rotundato-rhombicis, plerumque 3-lobis ac 3-veniis, abaxialiter manifeste



Figure 2. *Spiraea adiantoides* Businský. —A. Fertile branch in July of second year. —B. Two sterile long shoots with secondary lateral summer shoots. —C. Portion of fertile branch. —D. Inflorescence in fruit with basal leaf rosette. —E. Fully developed leaf of sterile long shoot, abaxial view. Drawn by Ludmila Businská, parts A and E from the holotype, *R. Businský* 30403 (G), B–D from isotypes.

cinereo-pruinosis venatione atroviridi discrepante distinguitur.

Shrubs to 50 cm tall, pruinose and generally glabrous, with slender, straight, terete branches; long shoots and branchlets conspicuously slender, terete, entirely glabrous, pale brown, initially smooth, cracking later, and peeling into longitudinal strips in the second year; buds small, subconical, shorter than petiole, with several scales sparsely pilose especially along margin, often sprouting during the first summer in vigorous shoots. Leaves pale green adaxially, conspicuously grayish pruinose and papillose abaxially, with revolute margin; venation reticulate, deep green, contrasting abaxially, in principal veins distinct adaxially; leaves entirely glabrous on both surfaces or only some young leaves with a few hairs on the petiole or principal veins abaxially; leaf blades of long shoots and lateral rosettes or shortest branchlets unequal in shape and size; blades on sterile long shoots more variable, broadly angular-obovate to transversally rounded rhombic, often wider than long with broadly cuneate to almost truncate base, or blades narrower, but at most  $1.5\times$  longer than wide with a minimum base angle ca.  $55^\circ$ , (3–)6–12(–17)  $\times$  (2.5–)6–12(–18) mm, excluding petiole; irregularly shallowly and orbicularly 3-lobed or only crenate to almost entire, middle lobe truncate, retuse, or crenulate, lateral lobes similar, but more irregular; venation consists of 3 principal veins branching at almost one point above base; petioles 1–2.5 mm, with 1/3–1/2 remaining after leaf fall; leaf blades of lateral rosettes at the inflorescence base small, entire, obovate or spatulate, with narrowly cuneate base and rounded to obtuse apex, to  $6.2 \times 2.7$  mm, including the petiole to 0.5 mm long, with one principal vein pinnately branched; blades on lateral shortest sterile branchlets of older twigs (usually also in rosettes) similar but somewhat more variable, to  $9 \times 4$  mm including petiole, entire or often shallowly 3- or 4-lobed; leaves on long shoots persist usually until second half of following year, thus inflorescences with the basal rosette of small entire leaves appear in axils of larger, lobed, broadly cuneate leaves from previous year. Inflorescences umbel-like, congested, few-flowered corymbs set laterally on straight branchlets (changed from previous year's long shoots); corymbs sessile or more often on (1–)2–3(–4) mm peduncle with basal leaf rosette in axil of previous year's leaf or its remnant petiole, bearing (3)4 or 5(to 7) flowers, each always singly on pedicel 5–7(–9) mm, slender, lax, usually entirely glabrous (sometimes with only sporadic hairs), grayish, the lower pedicel usually with diminished leaf at base, upper pedicels with small,

narrowly ligulate bract at base, the top pedicel with minute bract shifted up. Hypanthium campanulate, thinly walled, externally usually entirely glabrous (sometimes with sporadic hairs), grayish brown, inside with long white hairs, 1.6–2.3 mm diam. in fruit; sepals rounded triangular, 0.9–1.2(–1.4) mm, externally glabrous, inside finely pubescent or glabrescent, erect to spreading in fruit; petals obovate with retuse apex,  $2.9\text{--}3.5 \times 1.9\text{--}2.2$  mm; stamens ca. 20, shorter than petals, with filaments (1.3–)1.5–1.7(–1.9) mm; staminal disk indistinct, interrupted, formed by 10 small, rounded, lobed glandules; carpels inside, including bases of styles, with long whitish hairs. Follicles erect and parallel in maturity, 2.2–2.7 mm, sparsely hairy only along ventral suture; styles ca. 1 mm, dorsal, almost spreading.

*Habitat and distribution.* The new species occurs in fissures of open, sunny limestone rocks between 1700 and 2200 m along the foot of high mountain ranges, and is known only from two areas in northwestern Yunnan, China, at a distance of ca. 150 km.

*IUCN Red List category.* Vulnerable (VU; IUCN, 2001).

*Phenology.* *Spiraea adiantoides* flowers mostly in April to May.

*Paratypes.* CHINA. **Yunnan (NW):** Chungtien [Zhongdian], betw. Chiao-tou [Qiaotou] to Ya-chang-gou SE of Haba Snow Range on Yangtze, 23 Mar. 1939, *K. M. Feng* 567 (KUN [2], PE); Gongshan, Sigitong, 2000–2200 m, 20 Sep. 1940, *K. M. Feng* 7988 (KUN [2], PE [3]); Gongshan, Azhong Luo, 1700 m, 25 May 1960, *Chinese Collector* 8746 (KUN, PE [2]).

#### TWO TAXONOMICALLY CONFUSED SPECIES OF *SPIRAEA* FROM TAIWAN

According to relevant Chinese floras (Li, 1963; Yu & Lu, 1974; Ohashi & Hsieh, 1993; Lu & Crinan, 2003), only five species of the genus *Spiraea* are known from Taiwan. Three of them, *S. formosana* Hayata, *S. hayatana* H. L. Li, and *S. morrisonicola* Hayata, all with terminal compound corymbs, are traditionally classified into section *Calospira* K. Koch. Of the two species with simple inflorescences, *S. tarokoensis* Hayata from section *Chamaedryon* has umbel-like corymbs on short, lateral, leafy branchlets on the previous year's shoots, and *S. prunifolia* Siebold & Zucc. from section *Glomeratae* has sessile flower fascicles on the previous year's shoots (both according to the infrageneric classification of Yu & Kuan, 1963). In November 2008 during the ascent of the highest Taiwanese mountain, Yushan (Mt. Jade,

3952 m), along the classic tourist path from Tataka Visitor Center, the present author found a sporadic, low shrub of *Spiraea* growing on a sparsely wooded slope at 2800 m elevation (cf. *R. Businský 66401*). This shrub represents the group of typically seemingly umbellate species hitherto classified as an unspecified part of series *Trilobatae* Pojark. ex T. T. Yu from *Spiraea* sect. *Chamaedryon*, i.e., the group of several mostly Chinese species not known from Taiwan according to the above-mentioned Chinese floras. However, recently, during the compilation of a Red Data Book for endangered and threatened plants of Taiwan, one previously published species, *S. tatakaensis* I. S. Chen, was unexpectedly found described and illustrated thoroughly in a Chinese journal (Chen, 1978) not familiar to the taxonomists. Thus this taxon has been overlooked by previous botanists and could not be found in any works on the flora of Taiwan or China. The careful morphological comparison reveals that the above-mentioned shrub found by the present author is conspecific with *S. tatakaensis*. Because the protologue of this species is not easily available, the accurate description (compiled from *R. Businský 66401* and the original description and illustration) and the new illustration are given here.

***Spiraea tatakaensis*** I. S. Chen, *Formosan Sci.* 32(3): 53. 1978. TYPE: Taiwan. Tataka, Mt. Yuishan, 19 June 1977, I. S. Chen 5129 (holotype, TAIF not seen) Figure 3.

Shrubs to ca. 1 m tall, with relatively slender, terete, straight branches and shoots; long shoots densely grayish tomentose initially, beginning cracking and peeling in lower mature part at end of the first year; buds ovoid to obtusely conical, 1–2 mm, shorter than petiole, with several scales pilose on exterior surface initially, at least along margin later. Leaves coriaceous; deep green, finely rugose, with immersed veins, and sparsely sericeous adaxially; glaucous, distinctly papillose, with fine, contrasting venation, and laxly sericeous abaxially, with hairs more dense on prominent principal veins and on revolute margin; leaf blades angular-obovate to narrowly obovate, 1.5–3.5× longer than wide, narrowly cuneate proximally but often obtuse at very base, (15–)20–30(–35) × 7–17 mm; margin with 3 or 4 pairs of decreasing, incised, forward-pointed, coarse, acute teeth in upper half on sterile long shoots or usually with only 2 tooth pairs in upper third of narrower leaves on short fertile branchlets or in lower part of sterile long shoots; lower pair of largest teeth in broader leaves often in form of indistinct lateral lobes with 1 to 3 outer, minute, serrate teeth; apex of blade acute; venation

pinnate with usually 3 pairs of lateral veins leading to teeth apex, midvein and lateral veins raised abaxially; petioles 2–3 mm, with dense, long, sericeous hairs. Inflorescences seeming umbels on lateral, slender, leafy, 1–4 cm branchlets, with ca. 10 to 15 flowers, each always singly on slender, villous, ca. 1 cm pedicel. Hypanthium pubescent on both surfaces; sepals triangular, ca. 1 mm, externally glabrous, inside pubescent, spreading; petals white, suborbicular, 2–3 × ca. 3 mm, slightly emarginate; stamens ca. 20, shorter than petals, with filaments ca. 1.5–2 mm; carpels with long hairs inside and distally, style glabrous, ca. 1.5 mm. Follicles initially erect, ca. 2.5 mm, sparsely hairy chiefly along ventral suture near style insertion.

*Habitat and distribution.* *Spiraea tatakaensis* occurs on sunny forest margins or sparse woody slopes on slate or silicate ground, mostly between 1200 and 3200 m, often among trees of *Pinus taiwanensis* Hayata. Known only from one area in the central mountain range of Taiwan, particularly around the highest massif Yushan (Mt. Jade, 3952 m), *S. tatakaensis* is documented from the western and northeastern sides near the border of Chiayi and Nantou counties, and from a locality in Tanta valley ca. 35 km north-northeast of Mt. Yushan, in Nantou County.

*IUCN Red List category.* Least Concern (LC; IUCN, 2001).

*Phenology.* *Spiraea tatakaensis* flowers mostly in May to July.

*Notes.* The five cited collections of *Spiraea tatakaensis* at TAI and TAIF were incorrectly determined as *S. tarokoensis* and were also misidentified in the appendix to the new *Flora of Taiwan* treatment (Ohashi & Hsieh, 1993: photo 12), listing the former species under the name of the latter. *Spiraea tarokoensis* is locally endemic, known only from one limited area above the eastern coast of Taiwan, where it occurs at relatively low elevations. This rare species is inexactly described in the literature. According to Yu and Kuan (1963) and Yu and Lu (1974), *S. tarokoensis* is placed within the series *Mediae* Pojark. ex T. T. Yu, vaguely circumscribed from series *Trilobatae* (in which *S. tatakaensis* should be placed), based chiefly on the character of stamens shorter or subequal to petals versus stamens longer or slightly shorter than petals in the former. Although *S. tarokoensis* can be classified into the same group of seemingly umbellate species as *S. tatakaensis*, both species are quite dissimilar to each other, morphologically and also ecologically; *S. tatakaensis* is compared to *S.*



Figure 3. *Spiraea tatakaensis* I. S. Chen. —A. Branch in autumn of second year with fertile short branchlets in the terminal part after pedicels fell off. —B. Sterile long shoot. —C. Fully developed leaf of sterile long shoot, abaxial view. —D. Short branchlet with inflorescence. Drawn by Ludmila Businská, parts A–C from November collection, *R. Businský* 66401 (G), D from *Sheng-You Lu* 14766 (TAIF), both from the type locality.



*tarokoensis* and other seemingly umbellate species in Table 1. There are several discrepancies concerning *S. tarokoensis* in the *Flora of China* treatment (Lu & Crinan, 2003) and in Taiwanese floras (Li, 1963; Liu & Su, 1977; Ohashi & Hsieh, 1993). The illustration in the new *Flora of Taiwan* treatment (Ohashi & Hsieh, 1993: 156, pl. 71) is ascribed to *S. tarokoensis*, but is clearly not this species. Rather, plate 71 is certainly a drawing of *S. prunifolia*, approximately corresponding to *S. prunifolia* var. *pseudoprunifolia* (Hayata ex Nakai) H. L. Li. There is a second drawing of allegedly the latter taxon (but illustrated incorrectly with pubescent follicles) on the preceding plate 70 (Ohashi & Hsieh, 1993: 153). Given this confusion, an accurate description and the first illustration of *S. tarokoensis* correctly ascribed are given here, with both based on our collected material and the type.

*Selected specimens.* TAIWAN. **Nantou Co.:** Tong Puh-Mt. Morrison [Yushan], *Ih-Sheng Chen 3750* (TAI); Sinyihshian, Dandalindao [Tanta valley], *Aleck T. Y. Yang et al. 6038* (TAI); Loloku-Kuankao, *S. F. Huang 5273* (TAI). **Chiayi Co.:** [betw.] Tatchia [Tataka] & Paiyun Shelter, *Sheng-You Lu 14766* (TAIF); en route to Yushan, *T. C. Huang et al. 14253* (TAI); Yushan Natl. Park, Yushan (Mt. Jade) massif, S slopes of Mt. Jade Front Peak (3239 m), along path from Tataka (Paiyun) visitor center to Paiyun Lodge, *R. Businský 66401* [*Spiraea abscondita* Businský, nom. inval., in sched.] (G, RILOG herbarium).

***Spiraea tarokoensis*** Hayata, Icon. Pl. Formosan. 9: 38–39. [25 Mar.] 1920. TYPE: Taiwan. Hualien, Taroko, 27 Apr. 1917, *B. Hayata & S. Sasaki s.n.* (types, TI [2]). Figure 4.

Lax shrubs to ca. 1 m tall, with relatively slender branches; shoots basically terete, with slender longitudinal ridges and soon cracking and peeling surface, villous-tomentose initially; buds globose to ovoid, with many keeled, villous scales, often sprouting in vigorous long shoots and also in fertile branchlets into lateral summer shoots (usually longer than bearing fertile branchlets). Leaves pale green, almost glabrous and with not immersed veins adaxially, almost glabrous, glaucous and papillose abaxially, with revolute margin; venation reticulate, contrasting and on principal veins pubescent abaxially; leaf blades on sterile long shoots usually ovate to suborbicular, sometimes rhombic-ovate, 1.2–2× longer than wide, with rounded or broadly rounded cuneate base, (8–)12–25 × (7–)10–20 mm, shallowly 3-lobed or coarsely crenate mostly only in upper half, with lobes or teeth ± obtuse, usually secondarily crenate, and with obtuse to rounded apex; venation consists of 3 principal veins sparsely branched

upward, leading to teeth apex, raised abaxially; petioles 1.5–5 mm, villous; leaf blades on short fertile branchlets obovate, elliptic, or ovate, 7–16 mm, crenate or crenate to 3-lobed in upper third. Inflorescences seeming umbels on lateral, slender, leafy, 0.5–2.5(–5) cm, villous-tomentose branchlets, with 8 to 20 flowers, each always singly on slender, villous, 4–12 mm pedicel. Hypanthium and sepals villous on both surfaces; hypanthium shallowly funnel-shaped; sepals triangular with acute apex, 0.7–1.3 mm, spreading to reflexed; petals transversally obovate, emarginate, ca. 2 × 3 mm; stamens shorter than petals. Follicles suberect, 1.7–2.4 mm, with long hairs particularly on dorsal side; styles ca. 0.7–1.3 mm, dorsal, erect-spreading.

*Habitat and distribution.* *Spiraea tarokoensis* occurs on open limestone rocks or rocky sites between 400 and 1300 m. It is known only from the limited limestone area around Tienhsiang above Taroko gorge on the Pacific side of Taiwan's central mountain range, northwest of Hualien.

*IUCN Red List category.* *Spiraea tarokoensis* is certainly one of the rarest *Spiraea* species in the world. The difficult accessibility of rocky sites harboring the taxon is the most favorable factor in protecting it. However, a real risk for this species can be caused by wildfires or by construction or widening of roads (the population sampled by the present author at 950 m in 1991 was not found in 2008 due to road erosion and built-up protection). Therefore, this taxon is considered Vulnerable (VU) according to IUCN Red List criteria (IUCN, 2001).

*Phenology.* This species has been collected in flower in April to May.

*Selected specimens.* TAIWAN. **Hualien Co.:** Nai-taroko [Taroko Natl. Park], Kwarenko, *B. Hayata & S. Sasaki 68* (TAIF 12535, 12536 [s.n.], 12537); [Taroko Natl. Park] Yenhai logging trail, *Shih-Wen Chung 8006* (TAIF), *Pi-Fong Lu 9695* (TAIF); Taroko Natl. Park, limestone rocks of NE exposure along Central Cross-Island Hwy. near view above Tienhsiang (Tiansiang) ca. 1 km E of Hsipo hamlet, *R. Businský 32407* (G, RILOG herbarium).

#### TAXONOMIC CHANGES IN *SPIRAEA* FOR *FLORA OF CHINA*

Three taxa accepted in the *Flora of China* treatment (Lu & Crinan, 2003) as independent species are taxonomically changed here, either replaced in Chinese floras by a neglected taxon with a newly distinguished variety, synonymized, or relegated to the lower rank. Several new synonyms are also given.

Table 1. Comparison of *Spiraea tatakaensis* and *S. tarokoensis* from Taiwan with similar seemingly umbellate species occurring in mainland China.

Character	<i>S. tatakaensis</i>	<i>S. tarokoensis</i>	<i>S. siccanea</i>	<i>S. nishimurae</i>
Shoot indumentum (initial)	densely grayish tomentose	villous-tomentose	pubescent	pubescent
Leaf blade surfaces	deep green adaxially; glaucous, distinctly papillose, with contrasting venation, and laxly sericeous abaxially	pale green adaxially; almost glabrous and only on principal veins pubescent, glaucous and papillose abaxially	deep green adaxially; almost glabrous or only on principal veins pubescent and gray-green abaxially	light green on both surfaces; sparsely pubescent and without contrasting venation and papillae abaxially
Leaf blades on sterile long shoots				
Length, cm	mostly 2–3	mostly 1–2.5	1–2.5	mostly 1–2
Shape	angular-obovate to narrowly obovate, 1.5–3.5× longer than wide	ovate to suborbicular, 1.2–2× longer than wide	obovate or oblong	mostly rhombic-ovate to elliptic
Base	narrowly cuneate	rounded or broadly rounded cuneate	broadly cuneate to subrounded	narrowly cuneate
Margin	with 3 or 4 pairs of decreasing, coarse, acute teeth in upper 1/2	shallowly 3-lobed or coarsely crenate in upper 1/2, with lobes or teeth ± obtuse, secondarily crenate	shallowly 3-lobed and crenate above middle	with 2 or 3 pairs of coarse, secondarily serrate teeth or lobes in upper 2/3
Petioles				
Length, mm	2–3	1.5–5	2–5	1–3
Indumentum	dense, long, sericeous hairs	villous	sparsely pubescent or glabrous	sparsely pubescent
Inflorescences	ca. 10- to 15-flowered	8- to 20-flowered	mostly 7- to 15-flowered	7- to 25-flowered
Pedicels				
Length, mm	ca. 10	4–12	7–10	6–10
Indumentum	villous	villous	densely pubescent	sparsely pubescent
Distribution	central Taiwan	eastern Taiwan	northwestern Yunnan	north-central to northeastern China

**1. *Spiraea lasiocarpa*** Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 15: 536. 1842. TYPE: [Kazakhstan.] “Dzhungaria, ad fl. Sarkan,” s.d., *G. S. Karelin 1441* (holotype, LE).

[43°09'N, 81°07'E], s.d., *Xinjiang exped. 10530* (holotype, PE).

*Notes.* The names *Spiraea mongolica* Koehne (Koehne, 1893: 212) and *S. gemmata* Zabel (Zabel, 1893: 23) are referred to the autonymic variety of *S. lasiocarpa*. Both Koehne's and Zabel's names require nomenclatural investigation.

**1a. *Spiraea lasiocarpa* var. *lasiocarpa*.**

*Spiraea mongolica* Maxim., Bull. Acad. Imp. Sci. St.-Pétersbourg 27: 467. 1881. Basionym: *Spiraea crenifolia* C. A. Mey.  $\gamma$  *mongolica* Maxim., Acta Horti Petropol. 6: 181. 1879. TYPE: [China.] “Mongolia occid., Terra Ordos [western Nei Mongol], montibus Alaschan [Helan Shan], pars media decliv. occid.,” 18 June 1873, *Przewalski 295* (holotype, LE; isotype, PE).  
*Spiraea mongolica* Maxim. var. *tomentulosa* T. T. Yu, Acta Phytotax. Sin. 8(3): 216. 1963, syn. nov. TYPE: China. [Nei Mongol:] “Mongolia Interiora, Mt. Ala, in rupibus siccis, 1500–1700 m,” Aug. 1933, *W. Y. Hsia 3893* (holotype, PE).

*Spiraea mongolica* Maxim. var. *pubescens* Y. Z. Zhao & T. J. Wang, Bull. Bot. Res., Harbin 20(3): 259. 2000, syn. nov. TYPE: China. Xinjiang: [Ili Pref.], Zhaosu

**1b. *Spiraea lasiocarpa* var. *villosa*** Businský, var. nov. TYPE: China. Sichuan: Garze Pref., Dawu Xian, Dawu, foot of steep NE slopes above right bank of Xianshui He river SW opposite to town, grassy slope on limestone ground, 3100 m, 30°59'N, 101°07'E, 1 June 1992, *R. Businský 33403* (holotype, G; isotype, RILOG herbarium).

A varietate typica ramis novellis gemmis pedunculis et pedicellis villosis-tomentosis, foliis utrinque aequaliter villosis, hypanthiis et item sepalis extus villosis differt.

Table 1. Extended.

<i>S. pubescens</i>	<i>S. hirsuta</i>	<i>S. dasyantha</i>	<i>S. yunnanensis</i>
pubescent	pubescent	densely grayish tomentose	densely grayish tomentose
pubescent on both surfaces, not papillose abaxially	deep green adaxially; only sparsely pubescent abaxially initially	deep green adaxially; densely whitish tomentose abaxially	deep green adaxially; densely gray tomentose abaxially
2–6 rhombic-ovate to elliptic	2.5–6.5 obovate, rhombic-ovate, or elliptic	1.5–4.5 rhombic-ovate, 1.1–1.8× longer than wide	1–3.5 ovate, suborbicular, or obovate
narrowly cuneate or rounded cuneate with irregular coarse, sometimes secondarily serrate teeth, or shallow lobes in upper 1/2 or 2/3	narrowly to broadly cuneate or rounded cuneate serrate or serrate-lobed in upper 1/2 or 2/3	broadly cuneate to subcordate with 3 to 5 pairs of secondarily serrate teeth or lobes except base	broadly cuneate, rounded to subcordate shallowly crenate to incised obtusely lobed except base, secondarily serrate
2–6 pubescent	5–10 pubescent	2–5 densely tomentose	1–6 densely tomentose
15- to 40-flowered	> 20-flowered	10- to 25-flowered	5- to 30-flowered
5–15 glabrous or glabrescent central to northeastern China; Mongolia, Russia, Korea	mostly 10–20 densely pubescent central to southeastern China	6–10 densely gray tomentose central to eastern China	3–10 densely gray tomentose Yunnan and western Sichuan

This variety differs from *Spiraea lasiocarpa* var. *lasiocarpa* by the shoots and buds villous-tomentose (vs. mostly glabrous or pubescent in the autonymic variety), by the leaves including petioles ± densely villous equally on both blade surfaces including margin (vs. blades entirely glabrous or puberulous along usually lower margin portions), by corymbs with the peduncle and pedicels villous-tomentose (vs. entirely glabrous), and by the hypanthium and sepals villous externally (vs. glabrous).

*Notes.* *Spiraea lasiocarpa* was described from the Dzhungarskij Alatau Mountains (today's eastern Kazakhstan) from a locality close to the present Chinese border. It has been missing in important dendrological or specialized works (Zabel, 1893; Schneider, 1905; Rehder, 1927, 1940; Bean, 1981), or in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003), but known from Russian literature (e.g., Pojarkova, 1939; Shul'gina, 1954; Svjazeva, 1980)

and later known from floras of Pakistan (Stewart, 1972) and India (Purohit & Panigrahi, 1991). The autonymic variety representing the species was found to be taxonomically identical with *S. mongolica* Maxim. (Businský & Businská, 2002: 21), described from what is today the Chinese province of Nei Mongol, and as presented in Chinese floras (Yu & Lu, 1974; Fu & Hong, 2003; Lu & Crinan, 2003). *Spiraea gemmata* Zabel, another taxon conspecific with *S. lasiocarpa*, now to its autonymic variety, was described from cultivated plants of northern Chinese origin (Businský & Businská, 2002: 28), and this name has previously been used often in the literature (Schneider, 1905; Rehder, 1913, 1927, 1940; Bean, 1981; Maxwell & Knees, 1995) for the relevant Chinese plants. The correct name for this species widely distributed from Central Asia and the northwestern Himalayas to north-central China is *S. lasiocarpa*, by its nomenclatural priority. None of the

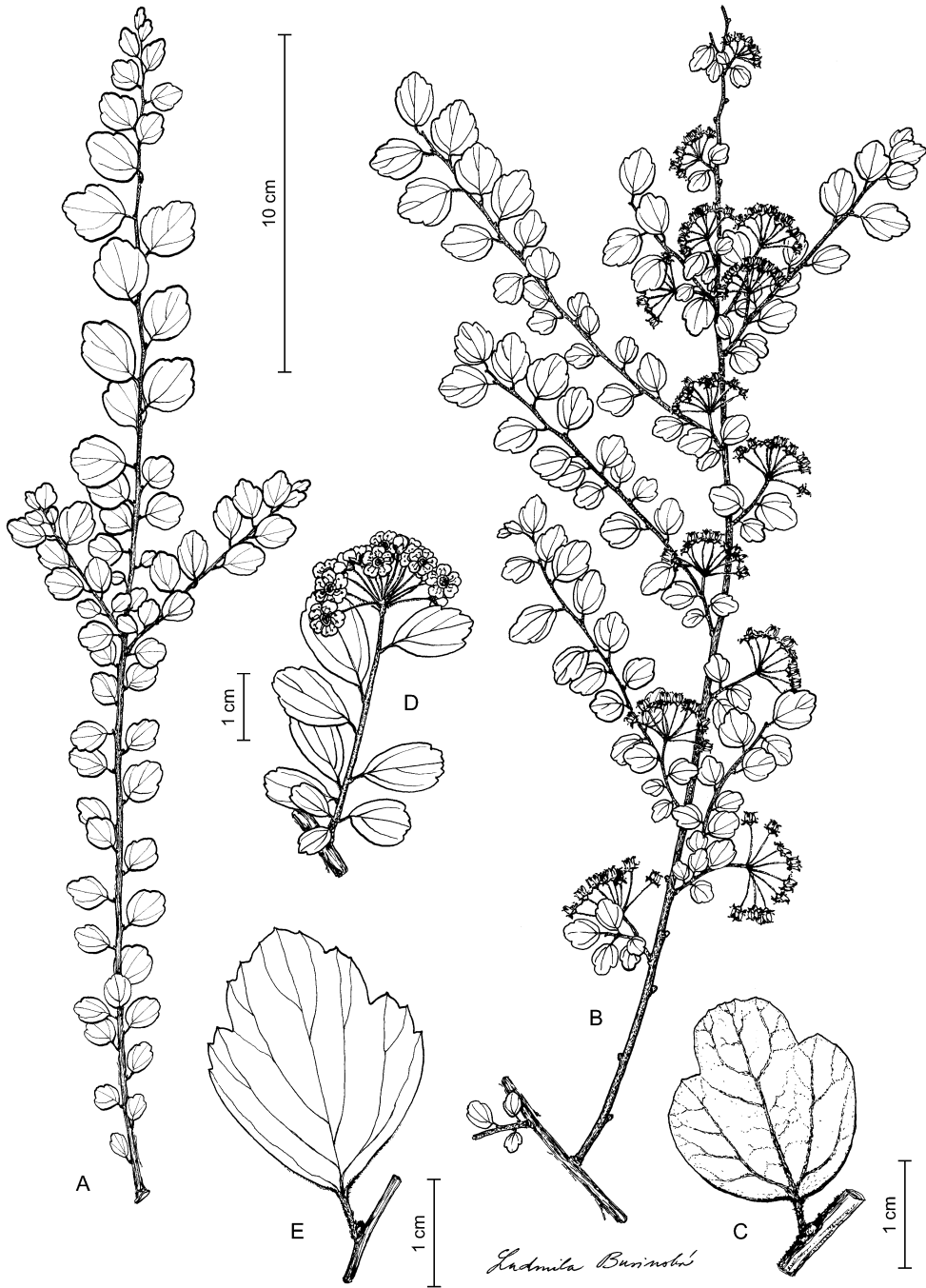


Figure 4. *Spiraea tarokoensis* Hayata. —A. Sterile long shoot with secondary lateral summer shoots. —B. Fertile branch with three-year basal portion and summer shoots grown laterally from bearing short fertile branchlets. —C. Fully developed leaf of sterile long shoot, abaxial view. —D. Short branchlet with inflorescence. —E. Fully developed leaf of sterile long shoot, adaxial view. Drawn by Ludmila Businská, parts A–C from December collection, *R. Businsky* 32407 (G), at the type locality; D and E from the type, *B. Hayata* & *S. Sasaki* s.n. (TI).

mentioned taxa are reported from the neighboring Mongolia (Grubov, 1982). The indumentum of *S. lasiocarpa* (including the follicles) varies from entirely glabrous morphotypes to wholly villous ones. Whereas the typical form is close to the first and glabrous extreme, the second one can be accepted at the rank of variety as newly described below. The taxa described as *S. mongolica* var. *tomentulosa* and *S. mongolica* var. *pubescens* represent not marked forms within the range of indumentum variation of *S. lasiocarpa* and are more closely affined to the typical form, therefore they are accepted as new synonyms for variety *lasiocarpa*. The opinion that *S. mongolica* var. *tomentulosa* and *S. ningshiaensis* T. T. Yu & L. T. Lu are conspecific (Zhao & Wang, 2000) is neither accepted in the *Flora of China* treatment (Lu & Crinan, 2003), nor here, because these taxa have a wholly different morphology in their winter buds (cf. the following key).

2. *Spiraea muliensis* T. T. Yu & L. T. Lu, Acta Phytotax. Sin. 13(1): 101. 1975. TYPE: China. Sichuan: Muli, Mengdong Shan, 2700 m, 21 June 1960, *Ying Jun-Sheng 4102* (holotype, PE).

*Spiraea daochengensis* L. T. Lu, Bull. Bot. Res., Harbin 9(2): 49. 1989, syn. nov. TYPE: China. Sichuan: Daocheng, 3800 m, 1 Sep. 1981, *Qing-Zang Exped. 5947* (holotype, PE).

*Notes.* These two imperfectly known taxa from southwestern Sichuan were accepted as separate species in the *Flora of China* treatment (Lu & Crinan, 2003). However, they are now found to be conspecific after careful comparison of both holotypes, as well as based on a study of the species variation at the newly found locality specified below. The holotype of *Spiraea daochengensis* represents a form with sparser indumentum on shoots, buds, both leaf blade surfaces, pedicels, and hypanthia including sepals externally, whereas the holotype of *S. muliensis* has all mentioned element surfaces densely villous.

*Specimen collected.* CHINA. **Sichuan:** Garze Pref., Jiulong Xian, bottom of upper Taka He valley, 3300 m, 29°01'N, 101°49'E, 5 July 2001, *R. Businský 51405* (G, RILOG herbarium).

3. *Spiraea media* Schmidt, Österr. Allg. Baumz. 1: 53, t. 54. 1792. TYPE: [Russia, West Siberia.] "Sibiria occid., prope fl. Irtyz," 1733–1736, *J. G. Gmelin s.n.* (type, LE not seen).

3a. *Spiraea media* var. *media*.

*Spiraea oblongifolia* Waldst. & Kit., Descr. Icon. Pl. Hung. 3: 261, t. 235. 1812. TYPE: [Hungary.] "Spiraea oblongifolia Metsekensis ex horto," s.d., *P. Kitaibel s.n.* (lectotype, designated by Kováts [1992: 50], BP).

*Notes.* The name *Spiraea confusa* Regel & Körn, published in 1857, has been used in the older literature (e.g., Rehder, 1927; Pojarkova, 1939), but no type was designated. The name is referred to the autonymic variety of *S. media*.

- 3b. *Spiraea media* var. *sericea* (Turcz.) Maxim., Acta Hort. Petrop. 6: 189. 1879. Basionym: *Spiraea sericea* Turcz., Bull. Soc. Imp. Naturalistes Moscou 16: 591. 1843. TYPE: [Russia (Chita Province) & China (NE Nei Mongol) border.] "Dahuria, in lapidosis ad fluvium Argun," s.d., *N. S. Turczaninow s.n.* (type, LE).

*Notes.* *Spiraea sericea* was accepted in Russian literature (e.g., Pojarkova, 1939; Shul'gina, 1954; Svjazeva, 1980) and in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003; Fu & Hong, 2003); it differs from typical *S. media* only by leaf blades laxly sericeous abaxially and initially pilose adaxially (vs. blades glabrous or almost glabrous in *S. media* var. *media*). Because the former taxon falls within the range of morphological variation and also geographical distribution of the latter, the former is accepted here only in the rank of variety.

KEY TO THE CHINESE SPECIES OF *SPIRAEA*

The following key contains all Chinese species accepted by the author for the genus *Spiraea* with lateral, simple inflorescences (with 1-flowered pedicels), usually classified into the two sections, *Spiraea* sect. *Glomeratae* and *Spiraea* sect. *Chamaedryon*. This taxonomic key substitutes for the corresponding portion in the *Flora of China* treatment (Lu & Crinan, 2003: 49–50, key leads 30–70), where several discrepancies were found. The crucial diagnostic character of the inflorescences as compound versus simple, is missing in the lead couplet (1) in the *Flora of China* key. Alternative constructions of some leads, believed more useful for determination, were compiled for the key presented here, which also excludes other less reliable characters previously used. Significant synonyms are given in parentheses in the key. Altogether, 40 species of *Spiraea* and one interspecific hybrid are included in the following key.

KEY TO THE CHINESE SPECIES OF *SPIRAEA* WITH SIMPLE INFLORESCENCES

- 1a. Inflorescences terminal or lateral, always compound, with branched pedicels ..... [28 Chinese species outside this study]
- 1b. Inflorescences always lateral, simple, with unbranched, 1-flowered pedicels (rarely some lower pedicels poorly branched).
- 2a. Flowers in sessile fascicles or shortly pedunculate (subsessile) crowded together corymbs, only with basal leaf rosette (*Spiraea* sect. *Glomeratae*).
- 3a. Leaves heteromorphic, those on sterile long shoots usually distinctly lobed or at least coarsely crenate-serrate, those in basal rosettes under inflorescences not lobed, entire.
- 4a. Long shoots and branchlets conspicuously angled, dark reddish brown initially ... *S. calcicola* W. W. Sm.
- 4b. Long shoots and branchlets terete, pale brown initially.
- 5a. Leaf blades glabrous on both surfaces.
- 6a. Long shoots entirely glabrous; leaf blades on sterile long shoots broadly angular-ovate to transversally rounded rhombic, mostly 3-lobed, 3-veined, conspicuously grayish pruinose, with contrasting venation abaxially ..... *S. adiantoides*
- 6b. Long shoots pubescent or puberulent initially; leaf blades on sterile long shoots obovate, elliptic, or suborbicular, mostly not lobed, usually pinnately veined, pale green or glaucous green and usually without contrasting venation abaxially .... *S. kwangsiensis* T. T. Yu
- 5b. Leaf blades densely pubescent or tomentose abaxially.
- 7a. Leaf blades on sterile long shoots mostly < 12 mm,  $\pm$  transversally obovate, flabellate,  $\pm$  deeply 3- to 5-lobed ..... *S. aquilegifolia* Pall.
- 7b. Leaf blades on sterile long shoots mostly > 12 mm, broadly ovate, obovate, or elliptic to suborbicular, coarsely crenate or shallowly 3-lobed, often secondarily crenate.
- 8a. Shoots tomentose; leaf blade often 3-lobed, with a few coarse, obtuse teeth above middle ..... *S. martini* H. Lév.
- 8b. Shoots pubescent; leaf blade not lobed, with many coarse, crenate teeth above base ..... *S. cavaleriei* H. Lév.
- 3b. Leaves homomorphic, those on sterile long shoots similar in shape to those in basal rosettes below inflorescences (disregarding numbers in serration or teeth).
- 9a. Leaf blades entire or at most with 2 to 4 coarse teeth near apex; long shoots and branchlets terete.
- 10a. Shoots glabrous or puberulent initially; leaf blades usually 15–20 mm; follicles glabrous. .... *S. hypericifolia* L.
- 10b. Shoots  $\pm$  densely pubescent initially; leaf blades shorter than 15 mm; follicles pubescent ..... *S. chailarensis* Liou (including *S. arenaria* Y. Z. Zhao & T. J. Wang)
- 9b. Leaf blades sharply serrate at least above middle (when only near apex then serration minute); long shoots and branchlets  $\pm$  angled.
- 11a. Leaf blades linear-lanceolate, glabrous on both surfaces ..... *S. thunbergii* Siebold ex Blume
- 11b. Leaf blades oblong, elliptic, or ovate, usually pubescent or villous on both or at least one surface.
- 12a. Leaf blades minutely serrate; long shoots and branchlets slightly angled; pedicels > 10 mm ..... *S. prunifolia*
- 12b. Leaf blades coarsely serrate; long shoots and branchlets conspicuously angled; pedicels < 10 mm ..... *S. muliensis*
- 2b. Flowers in corymbs, racemose corymbs, or seeming umbels, all on a peduncle continuing to leafy short branchlet (*Spiraea* sect. *Chamaedryon*, s. str.).
- 13a. Winter buds with 2 exterior valvate scales with acuminate apex (cf. Note 1).
- 14a. Leaf blades sharply serrate; stamens longer than petals; sepals reflexed in fruit.
- 15a. Leaf blades lanceolate, oblong-elliptic, or oblong-ovate, margin simply serrate above middle or only near apex; stamens ca. 20 ..... *S. flexuosa* Fisch. ex Cambess.
- 15b. Leaf blades broadly ovate, margin usually doubly serrate almost from base or above middle; stamens 35 to 50 ..... *S. chamaedryfolia* L.
- 14b. Leaf blades entire or apically crenate-serrate; stamens nearly equaling petals; sepals erect or spreading in fruit.
- 16a. Sterile shoots relatively long and slender; buds usually 2–5 mm; branchlets usually straight; leaf blades on sterile long shoots usually oblong-elliptic ..... *S. lasiocarpa*
- 16b. Sterile shoots relatively short and thick; buds usually 5–8 mm; branchlets arcuate; leaf blades on sterile long shoots ovate, elliptic, or obovate, rather broadly so ..... *S. mollifolia* Rehder (cf. Note 2)
- 13b. Winter buds with several exterior  $\pm$  imbricate scales usually with obtuse or acute apex.
- 17a. Prostrate shrub; flowers in  $\pm$  congested corymbs on a peduncle continuing to a very short branchlet with leaves almost crowded to basal rosette; (leaf blades broadly ovate, 0.8–1.5  $\times$  0.5–1 cm, long sericeous on both surfaces) ..... *S. pjassetzkii* Buzunova (including *S. prostrata* Maxim., nom. illeg.)
- 17b. Erect shrub, although sometimes lax; short branchlets bearing inflorescence with leaves arranged at  $\pm$  distinct intervals.

- 18a. Leaf blades usually < 8 mm wide and 2.5–5× longer than wide, entire, or sometimes with a few teeth near apex.
- 19a. Long shoots and branchlets terete, glabrous; sepals reflexed ... *S. dahurica* (Rupr.) Maxim.
- 19b. Long shoots and branchlets angled, pubescent initially; sepals erect or almost spreading.
- 20a. Leaves glabrous on both surfaces; petals white; follicles with subterminal, divergent styles ..... *S. alpina* Pall.
- 20b. Leaves pubescent on both surfaces; petals pinkish to purple-red; follicles with dorsal, suberect styles .....  
... *S. xizangensis* L. T. Lu (including *S. tibetica* T. T. Yu & L. T. Lu, nom. illeg.)
- 18b. Leaf blades on sterile long shoots usually > 8 mm wide and < 2.5× longer than wide, crenate, serrate, lobed, or sometimes entire.
- 21a. Long shoots and branchlets angled.
- 22a. Leaf blades broadly ovate, often sparsely denticulate above middle, sometimes shallowly 3-lobed, 3-veined; inflorescences < 2 cm wide ..... *S. ningshiaensis*
- 22b. Leaf blades elliptic, elliptic-oblong, or obovate-oblong, entire or sometimes denticulate at apex, pinnately veined; inflorescences usually > 2 cm wide ..... *S. myrtilloides* Rehder
- 21b. Long shoots and branchlets terete or almost terete.
- 23a. Flowers in corymbs or racemose corymbs (pedicels ± distant on inflorescence axis); stamens at least slightly to ca. 2× longer than petals.
- 24a. Leaf blades entire or coarsely serrate at apex or at most in upper third ..... *S. media*
- 24b. Leaf blades simply or doubly, sometimes obtusely serrate, incised serrate or serrate lobed, at least above middle.
- 25a. Shoots, leaf blades abaxially, pedicels, hypanthia externally, and follicles pubescent; sepals erect in fruit ... *S. sublobata* Hand.-Mazz.
- 25b. Shoots, leaf blades abaxially, pedicels, and hypanthia externally usually glabrous or nearly so, follicles glabrous, sometimes pilose along ventral suture or throughout (*S. anomala* Batalin).
- 26a. Leaf blades oblong-elliptic, oblong-ovate, or lanceolate-elliptic, with base cuneate; sepals erect in fruit .....  
..... *S. elegans* Pojark.
- 26b. Leaf blades ovate, triangular-ovate, elliptic-ovate, or broadly ovate, when lanceolate-ovate (sometimes in *S. anomala*) then with base truncate or subrounded; sepals usually reflexed or sometimes suberect in fruit.
- 27a. Corymbs 3- to 6-flowered, flowers 6–9 mm diam.; follicles hirsute throughout ..... *S. anomala*
- 27b. Corymbs 5- to 20-flowered, flowers 8–12 mm diam.; follicles glabrous or pilose along ventral suture.
- 28a. Leaf blades on sterile long shoots usually incised doubly serrate ..... *S. laeta* Rehder
- 28b. Leaf blades on sterile long shoots usually shallowly simply or doubly serrate.
- 29a. Leaf blades sericeous-villous on both surfaces, gray-green abaxially; inflorescences 12- to 20-flowered; flowers 8–10 mm diam. .... *S. papillosa* Rehder
- 29b. Leaf blades glabrous on both surfaces, pale-green abaxially; inflorescences 5- to 10-flowered; flowers 10–12 mm diam. ....  
..... *S. lichiangensis* W. W. Sm.
- 23b. Flowers in seeming umbels (pedicels densely crowded almost into one insertion point at apex of inflorescence axis); stamens shorter than or subequaling petals.
- 30a. Leaf blades glabrous or almost glabrous on both surfaces or puberulous on veins abaxially.
- 31a. Shoots pubescent or villous-tomentose initially.
- 32a. Shoots villous-tomentose initially, leaf petioles villous (eastern Taiwan) ..... *S. tarokoensis*
- 32b. Shoots pubescent initially, leaf petioles sparsely pubescent or glabrous (northwestern Yunnan) .....  
..... *S. siccanca* (W. W. Sm.) Rehder
- 31b. Shoots glabrous from initiation.
- 33a. Leaf blades on sterile long shoots rhombic-lanceolate to rhombic-oblong, with base narrowly cuneate and apex acute .....  
..... *S. cantoniensis* Lour.

- 33b. Leaf blades on sterile long shoots rhombic-ovate, rhombic-ovate, broadly ovate, or suborbicular, with base  $\pm$  broadly cuneate (sometimes shortly narrowed toward petiole), rounded or subcordate, and apex obtuse or subacute.
- 34a. Leaf blades bluish gray abaxially; fruits often not developing or irregularly developing (cultivated plants of cultural origin) ..... *S.  $\times$ vanhouttei* (Briot) Carrière (= *S. cantoniensis*  $\times$  *S. trilobata* L.)
- 34b. Leaf blades  $\pm$  pale green abaxially; fruits usually well developing (natural species usually not cultivated except in experimental plantations).
- 35a. Leaf blades on sterile long shoots suborbicular, usually with 1 or 2 pairs of lateral lobes, base often rounded or subcordate ..... *S. trilobata* L.
- 35b. Leaf blades on sterile long shoots rhombic-ovate or ovate, often with 2 or 3 pairs of lateral lobes, base broadly cuneate .....  
..... *S. blumei* G. Don (cf. Note 3)
- 30b. Leaf blades pubescent, sericeous, or tomentose throughout abaxial surface.
- 36a. Pedicels and hypanthia externally usually glabrous.
- 37a. Leaf blades on sterile long shoots narrowly elliptic to oblong-lanceolate, pubescent only abaxially .....  
..... *S. cantoniensis* var. *jiangxiensis* (Z. X. Yu) L. T. Lu
- 37b. Leaf blades on sterile long shoots rhombic-ovate to elliptic, pubescent on both surfaces ..... *S. pubescens* Turcz.
- 36b. Pedicels and hypanthia externally pubescent to tomentose.
- 38a. Leaf blades pubescent or sericeous abaxially.
- 39a. Leaf blades light green on both surfaces, mostly 1–2 cm ..... *S. nishimurae* Kitag.
- 39b. Leaf blades deep green adaxially and glaucous abaxially, mostly 2–5 cm.
- 40a. Shoots pubescent initially; leaf blades sparsely pubescent abaxially initially, petioles 5–10 mm; inflorescences > 20-flowered .....  
... *S. hirsuta* (Hemsl.) C. K. Schneid. (cf. Note 4)
- 40b. Shoots densely tomentose initially; leaf blades laxly sericeous abaxially at all times, petioles 2–3 mm; inflorescences < 20-flowered .....  
..... *S. tatakaensis*
- 38b. Leaf blades tomentose abaxially.
- 41a. Shoots initially and leaf blades abaxially yellowish or rusty yellow tomentose; sepals ovate-lanceolate ...  
..... *S. chinensis* Maxim.
- 41b. Shoots initially and leaf blades abaxially grayish to whitish tomentose; sepals triangular to ovate-triangular.
- 42a. Leaf blades on sterile long shoots rhombic-ovate, serrate, doubly serrate to  $\pm$  acutely lobed, with apex usually acute .....  
..... *S. dasyantha* Bunge (cf. Note 4)
- 42b. Leaf blades on sterile long shoots broadly ovate, suborbicular, or obovate, shallowly crenate to incised obtusely lobed and secondarily serrate, with apex obtuse or rounded ...  
..... *S. yunnanensis* Franch.

TAXONOMIC NOTES FOR CHINESE *SPIRAEA*

*Note 1.* The character of exterior bud scales in *Spiraea*, i.e., two valvate scales versus several imbricate ones, has been noted as diagnostic in the literature (e.g., Rehder, 1913, 1927, 1940; Pojarkova, 1939; Yu & Kuan, 1963), occasionally interpreted as “outer scales longer versus shorter than the

inner” (Ohwi, 1965: 519; Ikeda, 2001: 104). This character is reliable and stabilized to variable extent in *Spiraea* species. For instance, the state of two valvate bud scales is the conspicuous, stable character in *S. mollifolia*, but is not stable in *S. flexuosa* or *S. lichiangensis*. Reports for bud scales are quite confused for *S. miyabei* Koidz. (species with inflorescences compound), where the three known



Chinese varieties (var. *glabrata* Rehder, var. *tenuifolia* Rehder, var. *pilosula* Rehder) are reported to have small buds covered by several scales, whereas buds of the Japanese variety *miyabei* were observed with two distinctly long, acuminate, valvate scales (Businský & Businská, 2002). Generally speaking, the condition of bud scales is fully developed and the most distinct in mature winter buds, which are usually not present in herbarium specimens nor observed on plants during vegetation seasons. On the contrary, buds developing in the leaf axillae on immature shoots could be covered initially with valvate scales, which are ripped up later by the increasing bud with several imbricate scales.

*Note 2.* *Spiraea mollifolia* was studied by the present author in several populations from western Hubei (Dashennongjia massif) and southern Shaanxi (Qin Ling Mtns.) through western Sichuan and northwestern Yunnan to south-central Xizang (Lhasa environs). This species is easily recognized by its distinctive buds that are conspicuously long and narrow, as well as by the thick, angled shoots. However, it is also extremely variable in its indumentum, which varies from glabrous morphotypes to very densely villous ones, similarly and even more so than its sister *S. lasiocarpa*. For this reason, the indumentum characters used to discriminate these two species (the latter under the name *S. mongolica*) in the taxonomic key for the *Flora of China* treatment (Lu & Crinan, 2003) is not accepted here.

*Note 3.* *Spiraea alaschanica* Y.-Z. Zhao & T.-J. Wang (Bull. Bot. Res., Harbin 20[4]: 362. 2000) was described only from the type, *Ningxia Agric. College 60009* (holotype, NXAC), reported from Helan Shan (Ningxia, China), 23 May 1960. Because the original material is limited and not easily accessible, the identity of this taxon remains unresolved to date. In the *Flora of China* treatment (Lu & Crinan, 2003), it was mentioned as a problematic taxon only in the remark to *S. blumei* with which it was putatively related. According to the protologue (Wang & Zhao, 2000: 362), *S. alaschanica* corresponds with *S. blumei* except in the reported morphology of buds of the former “gemmae subulatae, biperulatae.” However, this character was assessed by the describing authors from young, undeveloped buds on material collected at springtime, although the obviously young bud on the accompanying illustration was described as a winter bud. For the reason that this character is not reliable in some species and is fully distinct in mature winter buds (cf. Note 1), *S. alaschanica* is provisionally accepted here as a synonym to *S. blumei*.

*Note 4.* *Spiraea nervosa* Franch. & Sav. (Enum. Pl. Jap. 2: 331. 1878) was incorrectly given in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003) as a synonym to the dissimilar *S. dasyantha* Bunge (Enum. Pl. Chin. Bor. 23. 1833). The former taxon is accepted as a Japanese endemic (Ikeda, 2001); however, its differences from the Chinese *S. hirsuta* (Bull. Herb. Boissier, ser. 2, 3: 342. 1905), examined on limited material and also from published characters, are insufficiently convincing, and these taxa could be conspecific. In this instance, the name of the Japanese taxon would have nomenclatural priority, but a more thorough comparative study is necessary.

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