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SALVIA SUBVIOLACEA, A NEW SPECIES FROM THE HIMALAYAS–HENGDUAN MOUNTAINS, CHINA

Y. K. Wei[1*], C. A. Pendry[2], Y. B. Huang[1], B. J. Ge[1] & H. W. Xiao[1]

Salvia subviolacea Y.K.Wei & Pendry, a new species from China, is described. *Salvia subviolacea* belongs to *Salvia* subg. *Glutinaria* (Raf.) G.X.Hu, C.L.Xiang & B.T.Drew, sect. *Eurysphace* E.Peter, and is distinguished from morphologically similar species by differences in its habit, leaves, inflorescences and flowers. It has a disjunct distribution in Sichuan and Xizang, and its *IUCN Red List* conservation assessment is Endangered. The Xizang population is under extreme threat and rapid conservation measures need to be taken.

Keywords. China, new species, *Salvia subviolacea*, *Salvia*.
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Introduction

The Hengduan Mountains are the easternmost extension of the Himalayas and are located in the Sichuan, Xizang and Yunnan Provinces of China. More than half of China's 83 species of *Salvia* L. are found in these provinces, and 23 species are endemic to the Hengduan Mountains (Wei *et al.*, 2015). The diversity of this region has still not been fully explored, and further investigations are much needed (Li & Hedge, 1994; Wei *et al.*, 2015), because new species of *Salvia* are still likely to be found there (Wang *et al.*, 2016). In this paper, we describe a new species of *Salvia* from Sichuan and Xizang and present a key to related species. Future papers will describe and document the ongoing research programme.

In 2011 and 2014, we collected a *Salvia* in Sichuan and Xizang that showed similarities to *Salvia dolichantha* E.Peter, *S. hians* Royle ex Benth., *S. przewalskii* Maxim. and *S. wardii* E.Peter but proved to be different from all these species. Further investigations in the field and comparison with herbarium specimens and living plants of these species have confirmed that our collections represent a new species, which is described and illustrated below.

Two subsequent surveys of the Xizang population in 2019 and 2020 found evidence of serious disturbance at the collecting locality, and no living plants could be located. It is evident that immediate measures need to be taken to protect this species.

[1] Shanghai Chenshan Botanical Garden, 3888 Chenhua Road, Shanghai 201602, China.
[2] Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, Scotland, UK.
* Corresponding author. E-mail: ykwei@aliyun.com.

Species description

Salvia subviolacea Y.K.Wei & Pendry, **sp. nov.**

Salvia subviolacea is distinguished from *S. dolichantha* E.Peter by its smaller flower and crenate leaf margin. *Salvia subviolacea* differs from *S. hians* Royle ex Benth. in its calyx and corolla; the former has a longer, narrower, uniformly deep violet to black calyx compared with the bicoloured green and deep violet, broadly campanulate calyx of the latter; furthermore, in the former the corolla tube is adnate to the calyx, whereas in the latter it is completely free. *Salvia subviolacea* differs from *S. przewalskii* Maxim. in its denser inflorescence and calyx that is much larger in relation to its corolla. It differs from *S. wardii* E.Peter in its smaller habit and smaller flowers, cordate leaves, and pale blue-purple to light purple corolla, in contrast to the deep blue flowers of *S. wardii*. – Type: China, Sichuan, Yanyuan, 3336 m, 27°40'21.34"N, 101°13'08.81"E, 28 vii 2014, *Y. K. Wei, H. Xu & Y.B. Huang* S0617 (holotype CSH [CSH0042695]; isotype CSH, E). **Figures 1, 2A,B.**

Perennial taprooted herb, 25–60 cm. *Stem* unbranched. *Leaves* almost all basal, occasionally with a pair of cauline leaves, all simple, papery, cordate to narrowly cordate, 7–20 × 5–15 cm, apex attenuate, acute or obtuse, base cordate, occasionally hastate, margin crenate. *Petiole* usually purplish, 5–15 cm. *Inflorescence* 20–35 cm, a relatively lax, pubescent raceme of 2- to 6-flowered verticillasters, simple or with up to 3 short branches at the base. *Calyx* uniformly violet or deep violet to black, tubular-campanulate, 12–21 mm, bilabiate to half its length, upper lip rounded, without an annulus, calyx and base of corolla tube adnate. *Corolla* pale blue-purple to light purple, tube curving slightly upwards at base, straight, with a lanate annulus at one-third above the base, upper and lower lips concolorous or white with concolorous spots, 26–40 mm. *Stamens* included in the corolla, filaments 5.1–8.1 mm, connective 4.5–6.5 mm, upper arm twice as long as lower arm, upper and lower thecae fertile, lower thecae coherent. *Pistil* 33–43 mm, stigma included within the upper lip. *Nutlets* subglobose, yellow-brown, c.2.8 × 2.3 mm. *Indumentum* of leaves puberulent or pubescent; petioles, stem, inflorescence and corolla pubescent, glandular pubescent only on the outside of the calyx.

Altitudinal range. 3000–4000 m.

Ecology. Forest margins and understorey, roadsides. It is apparently well adapted to various habitats. Flower colour is apparently influenced by environment, with a deeper colour in drier, sunnier locations.

Phenology. Flowering June to July, fruiting July to August.

Distribution. *Salvia subviolacea* is endemic to China and is currently known only from the type locality at Yanyuan, Sichuan Province, and Linzhi, Xizang Province.

Conservation status. *Salvia subviolacea* has been observed at only two sites, which are

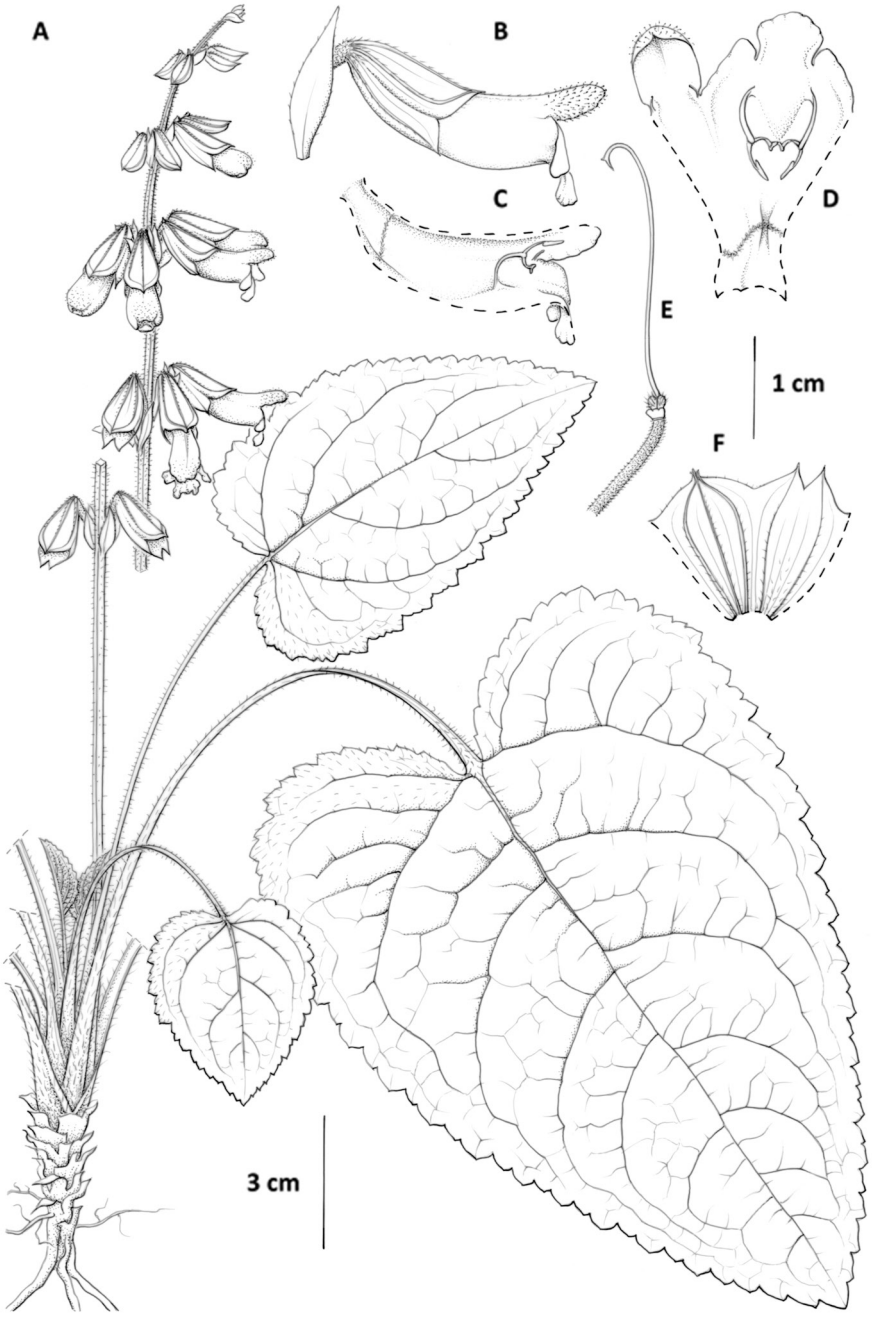

Figure 1. *Salvia subviolacea* sp. nov. A, Habit; B, flower (side view); C, flower (longitudinal section); D, corolla with stamens reflexed; E, ovary and style; F, dissected calyx (outer view). Scale bars: A, 3 cm; B–F, 1 cm. Drawn by Claire Banks from *Y. K. Wei, H. Xu & Y. B. Huang* S0617 (E).

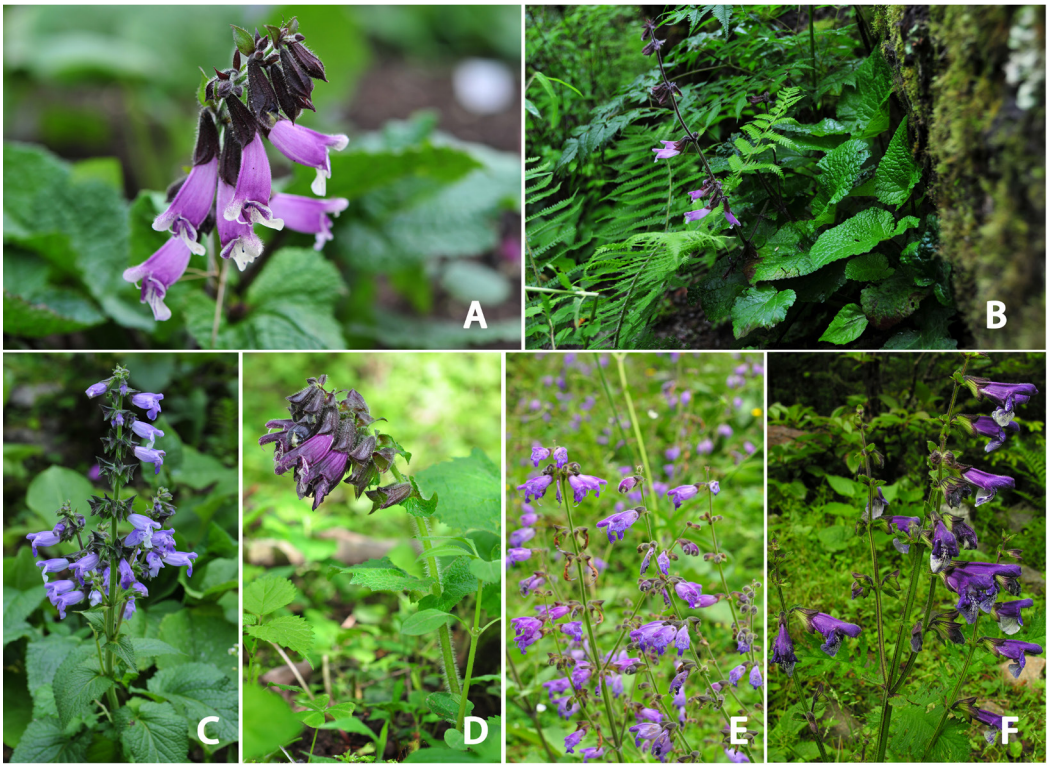

Figure 2. *Salvia subviolacea* and morphologically similar species: A and B, *S. subviolacea*; C, *S. wardii*; D, *S. dolichantha*; E, *S. przewalskii*; and F, *S. hians*.

about 360 km apart, among 403 localities surveyed for *Salvia* across Sichuan (83), Xizang (49) and Yunnan (271). Whereas the Sichuan population appears for now to be relatively steady, with between 250 and 2500 mature individuals, the Xizang population is under extreme threat. In 2019 this location was revisited but no living plants were found. The conservation assessment is therefore EN B2ac(iii) or C2b (IUCN Standards and Petitions Subcommittee, 2017).

Etymology. The epithet refers to the pale violet colour of the corolla.

Vernacular name. 川 藏 鼠 尾 草 ('Chuanzang sage').

Additional specimens examined. **Sichuan**: Yanyuan, Pass of Mianbu, 3240 m, 30 vii 2011, *E. D. Liu, C. L. Xiang, W. Fang, W. Z. Ma, G. X. Hu, Z. H. Wang & X. Nong* 2994 (PE, KUN [two duplicates]). **Xizang**: Linzhi, 3937 m, 29°34'11.75"N, 94°34'31.82"E, 16 vii 2011, *Y. K. Wei, B.J. Ge, L.J. Cui & G. Xu* S0239 (CSH [five duplicates]); Linzhi, Demula, 3900 m, 12 vii 2012, *C. Wang* LZ067 (BNU [one duplicate]).

Similarities and differences between these species are summarised in the Table, and their comparative morphology is shown in Figure 2.

Living material was collected but the plants have not survived at Shanghai Chenshan Botanical Garden. We will attempt to set up *ex situ* collections at the Kunming Institute of Botany, Yunnan.

Discussion

Wu & Li (1977) placed the Chinese species of *Salvia* in three subgenera (i.e. subg. *Allagospadonopsis*, subg. *Salvia* and subg. *Sclarea*) based on stamen structure and whether their lower arms are fertile and united. However, this classification has some obvious discrepancies, such as *Salvia nipponica* Miq. being placed in subg. *Salvia* despite its sterile lower arms, which place it in subg. *Sclarea*. Similarly, *Salvia substolonifera* E.Peter was incorrectly placed in subg. *Allagospadonopisis* when it actually belongs to subg. *Salvia* because of its fertile lower arms. A comprehensive re-examination of the Chinese *Salvia* was clearly much needed, with a particular emphasis on flowers from living plants.

Hu *et al.* (2018) established a new subgenus, *Glutinaria* (Raf.) G.X.Hu, C.L.Xiang & B.T.Drew, based on molecular evidence, and treated eight major subclades within it as sections. Section *Eurysphace*, with 45 species, is the largest of these sections and the vast majority of its species have a Sino-Himalayan distribution and are found at high elevations. These species were divided into two subsections: subsect. *Annuae* and subsect. *Perennes*. Subsection *Annuae* comprises three annual or biennial species (*Salvia roborowskii* Maxim., *S. tricuspis* Franch. and *S. umbratica* Hance), and subsect. *Perennes* includes 42 species (Hu *et al.*, 2018).

The species of subsect. *Perennes* can be divided into two groups – short connective and long connective – based on the relative ratio of connective to filament. In the short-connective group, the connective is obviously shorter than the filament, whereas in the long-connective group the connective equals or is longer than the filament. Within the short-connective group, there is a clear distinction between the species with smaller corollas (never exceeding 3 cm; mean, 2.5 cm) and of small stature (height less than 30 cm) and larger plants with corollas that exceed 3 cm (mean, almost 4 cm).

The group of small-flowered species includes *Salvia brachyloma* E.Peter, *S. brevilabra* Franch., *S. evansiana* Hand.-Mazz., *S. lankongensis* C.Y.Wu, *S. mairei* H.Lév., *S. schizochila* E.Peter and *S. wuana* C.L.Xiang. *Salvia subviolacea* belongs to the group with the larger flowers, which consists of almost 20 species including *S. dolichantha*, *S. przewalskii* and *S. wardii*. A key to this group is presented here.

Table. Morphological comparison of *Salvia subviolacea*, *S. dolichantha*, *S. hians*, *S. przewalskii* and *S. wardii*[a]

Character	*Salvia subviolacea*	*Salvia dolichantha*	*Salvia hians*	*Salvia przewalskii*	*Salvia wardii*
Habit	Small to medium	Small to medium	Medium to large	Medium to large	Large
Plant height (cm)	27–57 (mean, 44.4; *n* = 10)	29–56 (mean, 44.0; *n* = 13)	40–120 (mean, 63; *n* = 4)	21–88 (mean, 58.4; *n* = 37)	43–90 (mean, 65.9; *n* = 7)
Indumentum	Leaves puberulent or pubescent. Petioles, stem, inflorescence and corolla pubescent. Calyx glandular.	Leaves puberulent. Petioles, stem and inflorescence densely villose, calyx shortly villose, corolla puberulent.	Leaves, petioles, stem, inflorescence and flower sparsely pubescent. Glandular hairs present on calyx and inflorescence.	Indumentum dense throughout. Petioles, stem and inflorescence pubescent, tomentose or villous. Upper surface of leaves densely puberulous, lower surface more or less lanate. Inflorescence, calyx and corolla glandular hairy. Corolla white villous.	Leaves puberulent. Petioles, stem and inflorescence pubescent. Corolla glandular pubescent, calyx with longer, glandular hairs.
Leaf size (cm)	7–20 × 5–15 (mean, 12.4 × 8.9; *n* = 22)	6–24 × 6–22 (mean, 11 × 9.4; *n* = 31)	5–18 × 4–11 (mean, 11.6 × 7.1; *n* = 6)	5.5–20 × 3–13 (mean, 11.6 × 6.3; *n* = 58)	10–18 × 7–11 (mean, 13 × 8.2; *n* = 8)
Leaf shape	Cordate to narrowly cordate	Cordate to narrowly cordate	Cordate to narrowly cordate, lanceolate to broadly lanceolate	Lanceolate, ovate, subhastate and subsagittate	Lanceolate to broadly lanceolate
Leaf margin	Crenate	Dentate or incised	Crenate	Crenate	Crenate
Leaf apex	Acuminate, acute or obtuse	Acuminate	Acuminate or acute	Acute, occasionally obtuse	Acute or obtuse
Leaf base	Cordate, occasionally hastate	Cordate or hastate	Cordate to hastate	Hastate, subhastate or subcordate	Subcordate or subhastate
Leaf colour	Dark green above, a little lighter below	Light green	Green above, a little lighter below	Green above, grey-green to grey-white below. Petioles, veins and margin usually violet.	Green above, a little lighter below. Base of veins occasionally violet.
Underside of leaf	Puberulent to pubescent	Puberulous	Sparsely pubescent	More or less lanate-felted	Puberulent
Inflorescence length (cm)	20–35 (mean, 27.9; *n* = 10)	8–24 (mean, 15; *n* = 15)	9–30 (mean, 22.3; *n* = 8)	11–53 (mean, 28.6; *n* = 29)	7.5–54 (mean, 34.3; *n* = 13)
Inflorescence density/spacing of verticillasters	Relatively lax/medium to long	Dense/short	Lax/medium to long	Lax/long	Relatively dense/medium
Calyx					
Shape	Tubular-campanulate	Tubular-campanulate to campanulate	Broadly campanulate	Tubular to tubular-campanulate	Campanulate to broadly campanulate

Character	*Salvia subviolacea*	*Salvia dolichantha*	*Salvia hians*	*Salvia przewalskii*	*Salvia wardii*
Colour	Violet or deep violet to black, uniform	Deep violet to violet-green, bicoloured, variable	Green and deep violet bicoloured, variable	Deep violet or bicoloured, variable	Green to deep violet or bicoloured, variable
Length (mm)	12–21 (mean, 15.7; *n* = 22)	13–20 (mean, 17.7; *n* = 28)	11–16 (mean, 13.7; *n* = 6)	10–16 (mean, 12.3; *n* = 27)	12–17 (mean, 14.6; *n* = 27)
Calyx indumentum on throat inside	Scabrid, without annulus	Glabrous	Subglabrous to sparsely sericeous, without annulus	Glabrous, occasionally scabrid	Sericeous, without annulus
Adhesion between calyx and base of corolla tube	Adnate	Adnate	Free	Adnate	More or less free
Corolla					
Colour	Pale blue-purple to light purple; upper and lower lips concolorous or white with concolorous spots	Deep violet	Purple to light purple; lower lip white	Purplish red, pale purple, pale blue-purple, bluish purple	Deep blue
Length (mm)	26–40 (mean, 32.3; *n* = 20)	36–50 (mean, 41.0; *n* = 28)	27–35 (mean, 32.3; *n* = 6)	34–41 (mean, 36.5; *n* = 10)	33–50 (mean, 42.7; *n* = 30)
Ratio of calyx to corolla length	0.49	0.43	0.42	0.34	0.34
Position of lanate annulus within corolla tube	1/3 above tube base	1/5 above tube base	1/6 above base, rarely exannulate	1/4 above tube base	1/3 above tube base
Filament length (mm)	5.1–8.1 (mean, 7.3; *n* = 4)	9 (mean, 9.0; *n* = 2)	6–7 (mean, 6.3; *n* = 6)	7.7–9.5 (mean, 8.6; *n* = 10)	6.1–8.3 (mean, 7.4; *n* = 30)
Connective length (mm)	4.5–6.5 (mean, 5.1; *n* = 4)	5 (mean, 5.0; *n* = 2)	3.5–8 (mean, 6.6; *n* = 6)	4.4–7.6 (mean, 5.7; *n* = 10)	3.8–5.9 (mean, 4.9; *n* = 30)
Pistil length (mm)	33.2–43.1 (mean, 38.4; *n* = 4)	ND	33–44 (mean, 36.4; *n* = 7)	28.7–39.4 (mean, 36.0; *n* = 10)	34.3–48.5 (mean, 41.9; *n* = 29)
Nutlet shape	Subglobose	ND	Obovoid	Obovoid to prolate	Obovoid
Nutlet size (mm)	2.7–3.1 × 2.1–2.4 (mean, 2.8 × 2.3; *n* = 8)	ND	4 × 3 (mean, 4 × 3; *n* = 1)	3.1–4.4 × 2–2.7 (mean, 3.8 × 2.5; *n* = 46)	3.7–5.2 × 2.4–3.8 (mean, 4.3 × 2.9; *n* = 14)

ND, no data.

[a] Means have been calculated from measurements obtained from different plants.

Key to the Chinese species of the short-connective and big-flower group of *Salvia* subsect. *Perennes*

1a. Corolla straight or curving slightly upwards, tube almost equally wide at middle and mouth _____ 2
1b. Corolla curving upwards, sometimes somewhat S-shaped, much wider at mouth than in the middle _____ 9

2a. Connective less than 1/2 the length of the filament _____ 3
2b. Connective more than 1/2 the length of the filament _____ 4

3a. Corolla blue _____ *S. prattii* Hemsl.
3b. Corolla white to cream _____ *S. potaninii* Krylov

4a. Corolla length shorter than 3 cm _____ 5
4b. Corolla length longer than 3 cm _____ 6

5a. Leaves ovate with cordate base, pubescent above. Corolla curving slightly upwards, blue to white _____ *S. himmelbaurii* E.Peter
5b. Leaves circular-cordate to ovate-cordate, villous above. Corolla straight, purple to pale purple _____ *S. paohsingensis* C.Y.Wu

6a. Calyx campanulate. Corolla blue _____ *S. wardii*
6b. Calyx tubular-campanulate. Corolla yellow or deep purple to light purple _____ 7

7a. Corolla yellow. Leaf orbicular _____ *S. maximowicziana* Hemsl.
7b. Corolla blue to purple. Leaf cordate to narrowly cordate _____ 8

8a. Inflorescence dense with short internodes, densely villose. Corolla deep purple *S. dolichantha*
8b. Inflorescence relatively lax, pubescent. Corolla pale blue-purple to light purple **S. subviolacea**

9a. Plant 20–30 cm tall and usually unbranched. Corolla curving upwards _____ 10
9b. Plant 30–60 cm tall, branched. Corolla curving upwards, somewhat S-shaped _____ 11

10a. Leaf elliptic. Corolla pale purple or pink _____ *S. aerea* H.Lév.
10b. Leaf ovate. Corolla white to pale yellow _____ *S. cyclostegia* E.Peter

11a. Leaf tomentose _____ 12
11b. Leaf sparsely pubescent _____ 13

12a. Corolla pale yellow. Leaf oblong _____ *S. digitaloides* Diels
12b. Corolla purple, pale purple or purplish red. Leaf broadly lanceolate, hastate or ovate *S. przewalskii*

13a. Cauline leaves present _____ *S. atrorubra* C.Y.Wu
13b. Leaves all basal _____ 14

14a. Bracts prominent, orbicular. Inflorescence compacted, usually green *S. kiaometiensis* H.Lév.
14b. Bracts small, lanceolate. Inflorescence lax, usually purple _____ *S. castanea* Diels.

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