



Stixis yingjiangensis, a new species of Resedaceae from Yunnan, China

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ABSTRACT: *Stixis yingjiangensis* (Resedaceae), a new species from Yingjiang, Yunnan, China, is described and illustrated. It is compared with two morphologically similar species *S. philippinensis*, and *S. villiflora*. It differs from the two species by both surfaces with sparsely strigillose on lateral nerves, midrib and pustules (each pustule is formed by a multicellular cushion from which one short hair can also be produced), inflorescences axillary, racemes, 3–9 cm, filaments lower third pubescent, upper two thirds glabrous, androgynophores 2–3 mm, glabrous except apex sparsely puberulent, gynophores with densely white hairs, ovary glabrous. A complete morphological description of *Stixis yingjiangensis* is provided, together with photographs, a conservation assessment, and a diagnostic key to 4 species and 1 subspecies of *Stixis* from China.

KEY WORDS: China, new species, Resedaceae, *Stixis philippinensis*, *Stixis yingjiangensis*, *Stixis villiflora*, Yunnan.

INTRODUCTION

Traditionally the family Resedaceae Martinov contains 6 genera (*Caylusea* A. St-Hilaire, *Ochradenus* Delile, *Oligomeris* Cambess., *Randonia* Cosson, *Reseda* L., *Sesamoides* Ortega) and ca. 85 species, mostly distributed in the temperate and subtropical regions of the northern hemisphere (Martín-Bravo *et al.*, 2007; Çilden and Yıldırımli, 2021). The genus *Reseda* is the largest of the 6 genera of Resedaceae, and has about 65 species in the world, which extending from the Mediterranean region to the Canary and Cape Verde Islands, the Sahara and eastern Africa, and northwestern India, comprises annual or perennial herbs and generally grow in calcareous, gypsiferous soil and (semi)arid climates. (Abdallah and De Wit, 1978; Çilden and Yıldırımli, 2020, 2021; Martín-Bravo *et al.*, 2007; Martín-Bravo and Jimenez-Mejias, 2013; Yıldırım and Şenol, 2014). In APG IV (2016) to prevent unnecessary inflation of family names, Borthwickiaceae and Stixaceae were placed in an expanded family Resedaceae, members of which share some morphological characters (e.g. flowers with many stamens), although some share more characters with Gyrostemonaceae than with core Resedaceae. Traditionally *Stixis*, *Neothorelia*, *Forchhammeria* and *Tirania* were placed in the tribe Stixeeae of Capparaceae (Pax and Hoffmann, 1936), Doweld and Reveal (2008) proposed a familial rank for the tribe, Stixaceae. Su *et al.* (2012) through phylogenetic analysis established a new family Borthwickiaceae for the genus *Borthwickia* (formerly in Capparaceae). However, Gyrostemonaceae and Borthwickiaceae were not used by some scholars (APG III, 2009; Martín-Bravo *et al.*, 2009, 2010; APG IV, 2016). In this study the delimitation of *Stixis* followed the treatments of APG IV.

The genus *Stixis* was firstly established by De Loureiro (1790) and contains only one species *Stixis scandens* (distributed in China, India, Burma, and Laos), and the genus was later named *Roydsia* (Only one species was described, *Roydsia suaveolens* Roxb.) by Roxburgh (1819) and *Covilhamia* (Only one species was described *Covilhamia ovata* Korth.) by Korthals (1848). Six new species had been published since the establishment of the genus *Roydsia*, they are *R. fasciculata* King, *R. floribunda* Planch. ex Mast., *R. obtusifolia* Hook.f. & Thomson, *R. parviflora* Griff., *R. philippinensis* Turcz., *R. scortechinii* King (Jacobs, 1963).

Pierre (1887) revised the genus *Stixis* (contains *Roydsia suaveolens*, *R. floribunda*, *R. obtusifolia*, *R. parviflora*, *Stixis scandens*, and described 5 new species and 1 variety) and divided *Stixis* into two sections *Roydsia* (Stamens few or numerous, with short style or without style and with three or four distinct stigmas, fruits with one or two seeds) and *Alytostylis* (with long styles and three slender or united stigmas, fruits with one seed), This classification method is obviously unnatural and is not accepted by subsequent scholars. Jacobs (1963) made a systematic review of the genus, revised 29 existing plant names, and finally remained 7 species and 1 subspecies. Up to now the genus *Stixis* consists of 10 species and 1 subspecies of climbing shrubs, endemic to the Southeast Asia (Shen *et al.*, 2020).

To date China has recorded three species and one subspecies of the genus *Stixis*, and all these species were reported in Yunnan province (Chen *et al.* 2003, Zhang and Tucker 2008, Shen *et al.*, 2020). When we surveyed Extremely Small Population of plants in southwest Yunnan, the authors collected an unknown species in Dehong Dai and Jingpo Autonomous Prefecture. This species is similar to *Stixis philippinensis* (Turcz.) Merr., and *S. villiflora* J.Y. Shen, S. Landrein, W.G. Wang &



X.D. Ma, through the morphological anatomy of this species and the comparison of similar species and type specimens, as well as the relevant literature, we finally confirmed that this species has never been described.

TAXONOMIC TREATMENT

Stixis yingjiangensis J. Y. Shen *sp. nov.*

盈江斑果藤 Figs. 1–3

Type: CHINA, Yunnan, Dehong Dai and Jingpo Autonomous Prefecture, Yingjiang, Nabang, at the edge of the forest, climbing on the tree, 24°39' N, 97°35' E, alt. 930 m, 28 Mar. 2021, *J.Y. Shen & X.D. Ma 2395* (holotype: HITBC; isotype: HITBC, HIB. Acronyms according to Thiers 2021-onward)

Diagnosis: In terms of morphology, *Stixis yingjiangensis* exhibits morphology similar to *S. philippinensis* (Turcz.) Merr. and *S. villiflora* J.Y. Shen, S. Landrein, W.G. Wang & X.D. Ma, both of which calyx are reflexed at anthesis and with long gynophores (longer than 6 mm), but can be distinguished from them by several characters (See Table 1). *S. yingjiangensis* both leaf surfaces with sparsely strigillose on lateral nerves, midrib and pustules (each pustule is formed by a multicellular cushion from which one short hair can also be produced), while in *S. philippinensis* both surfaces glabrous except for a few pustules (without any hairs on it) above near the base of the midrib, and in *S. villiflora* both surfaces pubescent and pustulate (each pustule is formed by a multicellular cushion from which one to several hairs can also be produced), inflorescences axillary, racemes, 3–9 cm (vs. terminal, panicle, up to 25 cm long in *S. philippinensis*, axillary or terminal, racemes, 5–12 cm in *S. villiflora*), stamens 15–22, filaments lower third pubescent, upper two thirds glabrous (vs. 35–40(–48), filaments glabrous in *S. philippinensis*, 14–18, filaments lower half pubescent, upper half sparsely pubescent or glabrous in *S. villiflora*), androgynophore 2–4 mm, glabrous except apex sparsely puberulent (vs. 2–3 mm glabrous in *S. philippinensis*, ca. 1 mm, lower half glabrous, upper half tomentose in *S. villiflora*), ovary glabrous (vs. glabrous in *S. philippinensis*, densely white hairs in *S. villiflora*).

Climbing shrubs, ca. 2–8 m in height, woody. Twigs tan-colored, stout, terete, fulvous hairs, densely lenticellate. **Petiole** 10–15 mm, terete, tan-colored, with fulvous hairs, apically with a slightly inflated pulvinus. **Leaf blades** oblong, or oblong-lanceolate, 12–21 × 3–7 cm, both surfaces with sparsely strigillose on lateral nerves, midrib and pustules (each pustule is formed by a multicellular cushion from which one short hair can also be produced), acute or obtuse at base, apex acuminate and with a 10–15 mm tip, entire, broadest at middle, reticulate, herbaceous to subleathery, lateral nerves 7–9 on each side, arching obliquely towards the margin; midrib slightly sunken above, prominent beneath. **Inflorescences**

axillary, racemes, 3–9 cm, erect, axes white tomentose to downy-puberulous. **Bracts**, yellow, linear, 3–4 × 1 mm, caducous, pubescent. **Pedicels** 4–5 mm, pubescent. **Floral Buds** cylindroid, 2–3 mm diameter, 10–12 mm long. **Sepals** 6, in one whorl, reflexed at anthesis, lanceolate, 12–15 × 1 mm, apex acute to obtuse, inner surface yellow-green, densely tomentose, outer surface the base is orange-red and the rest yellow-green, sparsely puberulent. **Androgynophore** 2–3 mm, glabrous except apex sparsely puberulent. **Stamens** 15–22. **Filaments** 12–15 mm, white later turn to yellow, lower third pubescent, upper two thirds glabrous. **Anthers** ellipsoid, ca. 0.5 mm long, bright yellow. **Gynophore** 6–10 mm, elongating slightly during and after anthesis, with densely white hairs. **Ovary** ellipsoid, ca. 4 × 3 mm, glabrous, 3-loculed, placentation axile, placentae each with 5–6 ovules. **Style** 1–2 mm long, glabrous, stigma obscurely 3 lobed. Fruit not seen.

Distribution and habitat: Currently only two populations have been found in Yingjiang County, the first population (8 individuals were observed) in Nabang Town, at the edge of the forest, climbing on the tree. The second population (only two individuals were observed) in Kachang Town, grew by the roadside, the site (25°02'N, 97°43'E, alt. 664 m) is only about 200 meters from Myanmar as the crow flies. Since both populations are located along the China-Myanmar border, perhaps this species also has distribution in Kachin State of Myanmar.

Phenology: Flowers were observed from late March to early April.

Etymology: The specific epithet is derived from the type locality, Yingjiang County, Dehong Dai and Jingpo Autonomous Prefecture, Yunnan, China.

Conservation assessment: There are only two known populations of *Stixis yingjiangensis* in Yingjiang County (Dehong Dai and Jingpo Autonomous Prefecture, Yunnan Province, China). All the surrounding forests were surveyed carefully, but no additional populations were observed. Since the species is found on the border between China and Myanmar, perhaps also distributed in the Kachin State side of Myanmar, and in China side the investigation has not been through enough to fully understand the natural distribution of the species. According to IUCN Red List criteria (2019), this new species should be assessed as Data Deficient (DD; criteria B1ab(i–v) + 2ab(i–v)).

Discussion: As mentioned in the diagnosis, the species most similar to *Stixis yingjiangensis* is *S. philippinensis*, both species with reflexed sepals, long gynophores and glabrous ovary, but *S. yingjiangensis* both leaf surfaces with sparsely strigillose on lateral nerves, midrib and pustules, inflorescences axillary, racemes, stamens 15–22, filaments lower third pubescent, upper two thirds glabrous, which can be easily distinguished from *S. philippinensis*.

Yunnan Province is located at the southwest border of

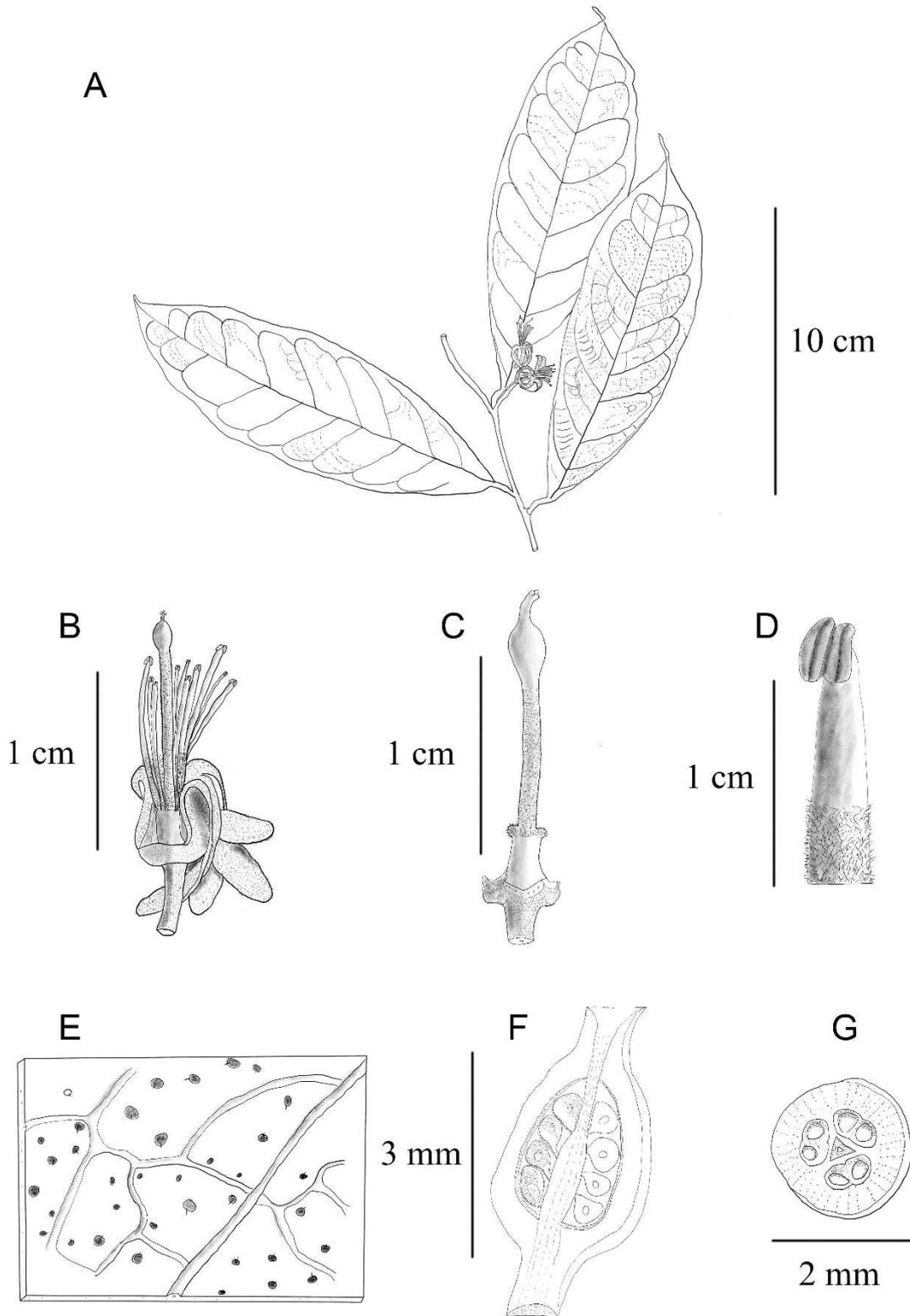


Fig.1. *Stixis yingjiangensis*. A. Flowering branch. B. Flower with corolla opened showing staminal column and nectary. C. Flower remove sepals and stamens to show androgynophore, gynophore and pistil. D. Stamen. E. Adaxial leaf surface. F. Longitudinal section of the ovary. G. Cross section of the ovary. (Drawn by Jian-Yong Shen)

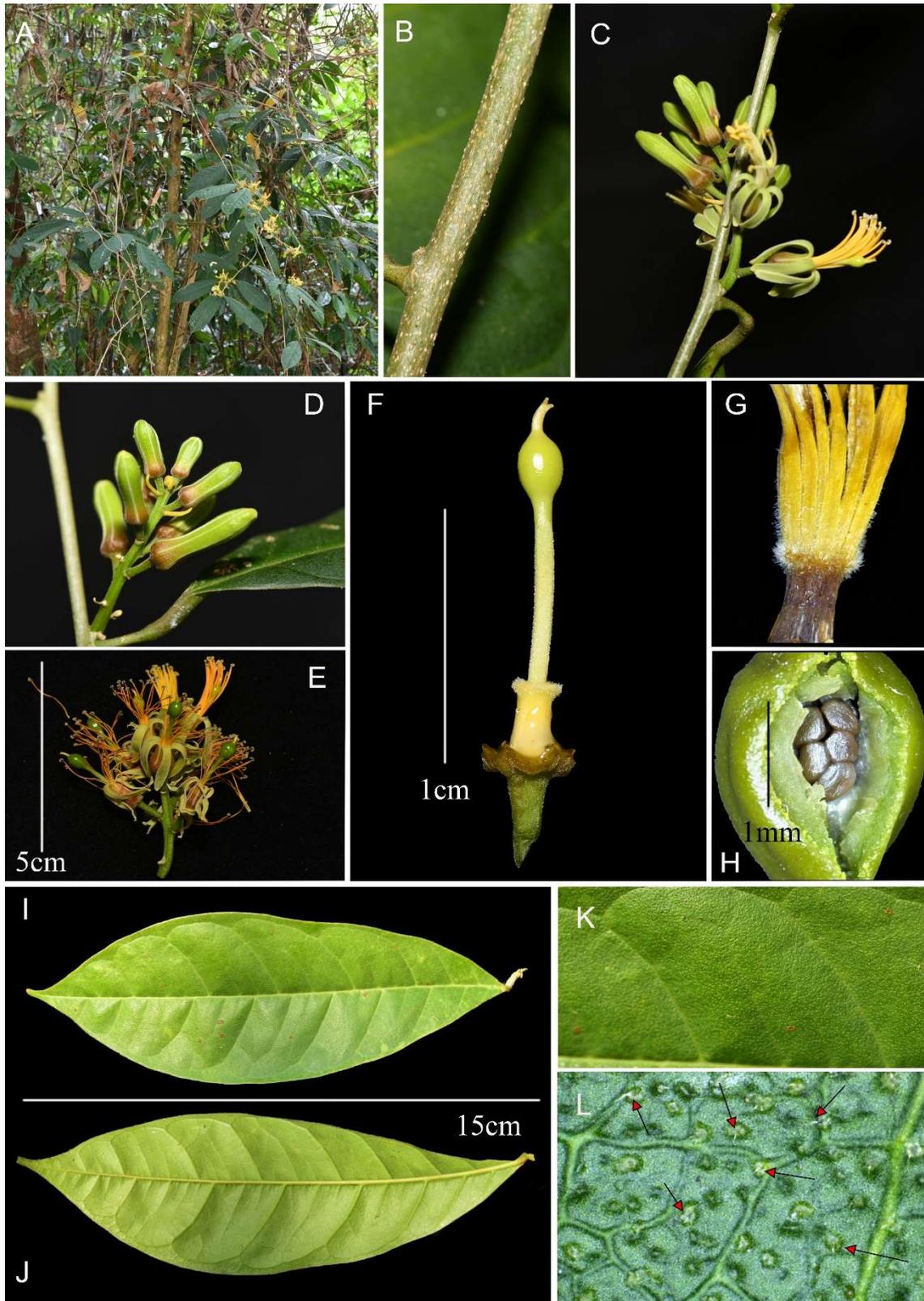


Fig. 2. *Stixis yingjiangensis*. **A.** Habitat. **B.** stem. **C-E.** Flowers from different periods. **F.** Flower dissection (remove sepals and filaments) to show androgynophore, gynophore, pistil. **G.** hairs on the top of androgynophore and base of filaments. **H.** Ovary opened longitudinally showing the ovules. **I-J.** Adaxial and abaxial leaf surface. **K.** Adaxial leaf surface to show the pustules. **L.** Adaxial leaf surface to show hairs (red arrows) on the pustules (Photo by Jian-Yong Shen).

Table 1. Morphological comparison of *Stixis yingjiangensis*, *S. villiflora* and *S. philippinensis*.

Characters	<i>S. yingjiangensis</i>	<i>S. villiflora</i>	<i>S. philippinensis</i>
Leaf surface	both surfaces with sparsely strigillose on lateral nerves, midrib and pustules (each pustule is formed by a multicellular cushion from which one short hair can also be produced)	both surfaces pubescent and pustulate (each pustule is formed by a multicellular cushion from which one to several hairs can also be produced)	both surfaces glabrous except for a few pustules above near the base of the midrib
Leaf shape	oblong, or oblong-lanceolate, 12–21 × 3–7 cm	oblong, or oblong-lanceolate, 8.5–21 × 3–7.5 cm	elliptic to oblong, (9–)13–21(–25) × (6–)8–10(11.5) cm
Leaf apex	acuminate and with a 10–15 mm tip	acuminate and with a 10–20 mm tip	acuminate and with a ca. 5 mm tip
Inflorescences	axillary, racemes, 3–9 cm, erect, axes white pilose	axillary or terminal, racemes, 5–12 cm, erect, axes tomentose to downy-puberulous	terminal, panicle, up to 25 cm long, branches up to 15 cm, axes fulvous-puberulous
Stamen	15–22, filaments 12–15 mm, lower third pubescent, upper two thirds glabrous	14–18, filaments 10–14 mm, lower half pubescent, upper half sparsely pubescent or glabrous	35–40(–48), filaments 10–15(–16) mm, glabrous
Androgynophore	2–3 mm, glabrous except apex sparsely puberulent	ca. 1 mm, lower half glabrous, upper half tomentose	2–3 mm, glabrous
Gynophore	7–10 mm long, with densely white hairs	7–10 mm long, with densely white hairs	8–11 mm long, with densely puberulous
Ovary style	glabrous one, ca. 1 mm, glabrous	densely white hairs one, ca. 1 mm, sparsely hirsute at the base, otherwise glabrous	glabrous one, 1.5–2.5 mm, glabrous
stigma	3	3 (or 4)	3

Fig 3. Holotype of *Stixis yingjiangensis*.

China, bordering Myanmar, Laos and Vietnam with a land border of 4,061 kilometers. It is the province with the richest biodiversity in China. *S. villiflora* and *S. yingjiangensis* were discovered in Xishuangbanna and Dehong prefectures of Yunnan Province in recent two years, which happened to be the hotspots of Yunnan biodiversity. In the southwest of Yunnan, only Dehong and Xishuangbanna prefectures still have tropical rain forests. In the past 50 years, large-scale rubber cultivation has been carried out in the tropical areas of Yunnan below the altitude of 800 meters. As a result, the area of the tropical rain forest in Yunnan has been decreasing year by year, which has brought a devastating blow to a lot of plant species. At present, the whole Yunnan region, in addition to the protected areas can also see the primeval forest, outside the protected areas have been basically occupied by various cash crops. It is expected that the government will introduce more policies in the future to take effective measures to protect species at risk of extinction.

Specimens of *S. philippinensis* examined: Philippines.

Luzon, Laguna, 1841, *H. Cuming 541* (BM, G, K, L, P, MSU). Luzon, Laguna, May 1916, C. Mabesa 26315 (L). Surigao, Mindanao, Aug. 1916, A. Mallonga 26266 (US). Luzon, Laguna, May 1915, F. Bawan 24199 (BM, US). Luzon, Laguna, Dec. 1910, McGregor RC 454 (L, P, US). Santa Cruz, Davao, S.E. Mindanao, 19 Apr. 1905, R. S. Williams 2718 (US). Luzon, Laguna, Mt. Mariveles, Lamao River, Dec. 1904, T. E. Borden 24037 (US). Luzon, Laguna, Mt. Mariveles, Lamao River, Dec. 1904, R. Meyer 2263 (US). Luzon, Laguna, 1888, O. Warburg 13483 (US).

Specimens of *S. villiflora* examined: China.

Yunnan, Mengla, Guanlei, in dense forests, climbing on the tree, 21°45'N, 101°12'E, alt. 1284m, 16 Mar. 2019, *J.Y. Shen, X.D. Ma & W.G. Wang 1413* (HITBC, HIB, KUN).



Taxonomic key to the 4 species and 1 subspecies of *Stixis* known from China.

- 1a Sepals reflexed in anthesis 2
 1b Sepals more or less spreading during anthesis, not reflexed 3
 2a Ovary hairy *S. villiflora*
 2b Ovary glabrous *S. yingjiangensis*
 3a Gynophore longer than 6 mm *S. suaveolens*
 3b Gynophore shorter than 5 mm 4
 4a Inflorescences 12–35 cm, branched; stamens (20–)26–30(–40); style 1–1.5 mm; fruit ca. 4 cm *S. ovata* subsp. *fasciculata*
 4b Inflorescences 5–9 cm, mostly unbranched; stamens 16–24; style ca. 0.5 mm; fruit ca. 2 cm *S. scandens*

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