

## OBSERVATIONS AND A NEW SPECIES IN THE GENUS *PSEUDOPYXIS* (*RUBIACEAE*)

TAO CHEN

Specimens of *Pseudopyxis* Miq. (*Rubiaceae*) from China and Japan were studied and compared. As the plants from China differ considerably from those from Japan a new species, *Pseudopyxis monilirhizoma* T.Chen, is described and a key to *Pseudopyxis* is presented.

*Keywords.* China, East Asia, *Pseudopyxis*, *Pseudopyxis monilirhizoma*, *Rubiaceae*.

### INTRODUCTION

The genus *Pseudopyxis* Miq. was first described from only one representative species, *P. depressa* Miq., and placed in the *Boraginaceae* tribe *Boragineae* by the Dutch botanist Miquel (1867b) based on material from Japan. Maximowicz (1873) pointed out that Miquel's positioning of the genus was incorrect and transferred it to the *Rubiaceae*. Meanwhile, Hooker (1873) tentatively placed the genus in the tribe *Paederieae*. Franchet & Savatier (1879) described an additional species, *Pseudopyxis longituba* Franch. & Sav., from Japanese material with corollas 20–25 mm long. A decade after his earlier taxonomic treatment, Maximowicz (1883) discovered that Miquel (1867a) had published another species of *Pseudopyxis* as *Oldenlandia heterophylla* Miq., for which he created the new combination *P. heterophylla* (Miq.) Maxim. Maximowicz also took up the name *Pseudopyxis longituba* Franch. & Sav., which was subsequently included in *P. depressa* because its characters were within the range of variability of the latter (Ohwi, 1953, 1965; Yamazaki, 1993). In addition, a species described by Petitmengin (1907) in the *Primulaceae*, *Lysimachia quadriflora* Petitm., was recombined by Handel-Mazzetti (1928) as *Pseudopyxis quadriflora* (Petitm.) Koidz. ex Hand.-Mazz. However, it is predated by *Pseudopyxis heterophylla*.

*Pseudopyxis* was thought to be endemic to Japan. Puff (1989a, 1989b) studied its taxonomic relationships and position within the family *Rubiaceae* but material from eastern China was not included. Zheng (1981) recognized Chinese material from Zhejiang as a new record of *Pseudopyxis heterophylla* for China and this was subsequently accepted in *Flora Reipublicae Popularis Sinicae* (Luo, 1999). This is of great phytogeographical importance for the interpretation of Sino-Japanese floristic relationships. However, both authors noted differences between the Chinese and Japanese material.

During a recent study of *Rubiaceae* for the Flora of China Project at the Harvard University Herbaria, I examined the Japanese material and compared it with specimens from China. The Chinese material could be easily misidentified as a member of *Hedyotis* L. or *Oldenlandia* L., but the plants clearly differ from them in having rhizomes with dichasial sympodial branching; aerial shoots unbranched, a faint foetid odour when crushed; multicellular hairs on the stem, pedicels and ovary; the basal stem region with a pair of reduced scale-like leaves; stipules interpetiolar, triangular or with a 3(or 5)-toothed apex and tipped by a colleter, the base fused into a sheath; terminal inflorescences subtended by a pair of leaf-like bracts; the flowers mostly 5-merous, with a slightly fleshy disk or operculum in the upper part of the calyx tube covering the ovary; the pedicels elongated and curved during fruit maturation; the corolla pink or white; the calyx persistent, with lobes enlarging during fruit maturation; the ovary (4- or)5-locular with basal placentation; with 1 anatropous ovule per locule; the fruit opening by a round, apical lid; and the seeds or diaspores obovoid, with many longitudinal idioblasts containing raphides.

Observations indicate that the material from China is rather similar to that of both *Pseudopyxis depressa* and *P. heterophylla* from Japan but differs conspicuously (Table 1). Because of these differences, a new species of *Pseudopyxis* is here recognized from China (Fig. 1) and a key to the species of the genus is provided as follows.

*Key to species of Pseudopyxis*

- 1a. Rhizomes frequently branched, not enlarged or constricted, internodes usually less than 2 cm long; stems 15–30 cm long \_\_\_\_\_ *P. heterophylla*
- 1b. Rhizomes sparsely branched, conspicuously enlarged, internodes usually more than 2 cm long; stems to c.10 cm long \_\_\_\_\_ 2
- 2a. Rhizomes slightly enlarged at internodes; stems uniformly hairy \_\_\_\_\_  
\_\_\_\_\_ *P. depressa*
- 2b. Rhizomes markedly enlarged at nodes; stems with hairs in 2 rows \_\_\_\_\_  
\_\_\_\_\_ *P. monilirhizoma*

***Pseudopyxis monilirhizoma* T.Chen, sp. nov. Fig. 1.**

Species insignis rhizomatibus moniliformibus laxis, a speciebus notis distincta. Differt a *Pseudopyxis depressa* Miq. rhizomatibus valde accrescentibus nodis lignosis, caulibus bilateraliter dense breviterque hirtellis, inflorescentiis terminalibus vulgo (2–)4-floribus, corollis hypocrateriformibus externe glabris, corollae tubo filiformi circa 5 mm longo, corollae lobis lanceolatis vel oblongis-lanceolatis circa 4 mm longis apicibus leviter uncatis, stylo atque antheris valde exsertis, ovario costato costis dense hirtis; a *P. heterophylla* (Miq.) Maxim. rhizomatibus extensis sparsim ramosis, internodiis vulgo 2 cm longis vel ultra, caulibus 5–10 cm altis, foliis 3- vel 4-jugis maximis in parte superioris caulium, floribus axillaribus vulgo solum in primis nodis infra inflorescentias terminales, corolla intus pilosa, calycis lobis leviter accrescentibus tempore maturationis fructus distinguitur.

TABLE 1. Diagnostic morphological characters of *Pseudopyxis depressa*, *P. heterophylla* and *P. monilirhizoma*

|  | <i>P. depressa</i>   | <i>P. heterophylla</i>                                     | <i>P. monilirhizoma</i>   |
|--|--|--|---|
| Rhizome systems                            | Extensively, sparsely branched; slightly enlarged and long claviform at internodes | Compact, frequently branched; not enlarged or constricted  | Extensively, sparsely branched; markedly enlarged and fusiform at nodes |
| Rhizome internodes                         | Usually longer than 2 cm   | Usually shorter than 2 cm                                  | Usually longer than 2 cm  |
| Buds of aerial stems                       | Widely spaced  | Closely spaced   | Widely spaced   |
| Aerial stems                               | Up to c.10 cm tall   | Up to 30 cm tall   | Up to c.10 cm tall  |
| Stem internodes below inflorescence region | Uniformly hairy  | Hairs in 2 rows  | Hairs in 2 rows   |
| Leaves                                     | 3 or 4 pairs, largest ones in upper stem region                                    | 5 or 6 pairs, largest ones near mid-stem region            | 3 or 4 pairs, largest ones in upper stem region                         |
| Corolla                                    | Pale purple, glabrous or thinly pilose outside, hairy inside                       | White, glabrous on both sides                              | White or pink, glabrous outside, thinly pilose inside                   |
| Corolla tube                               | Narrowly funnel-shaped   | Slender, abruptly dilated at upper part                    | Slender, filiform, dilated at upper part                                |
| Corolla lobes                              | Ovate, wavy or crinkly at margin, faintly tripartite at apex                       | Narrowly oblong, obtuse and slightly hooked at apex        | Lanceolate or narrowly oblong, acute and slightly hooked at apex        |
| Ovary                                      | Not ribbed, densely hairy  | Ribbed and densely hairy on ribs below base of calyx lobes | Ribbed and densely hairy on ribs below base of calyx lobes              |

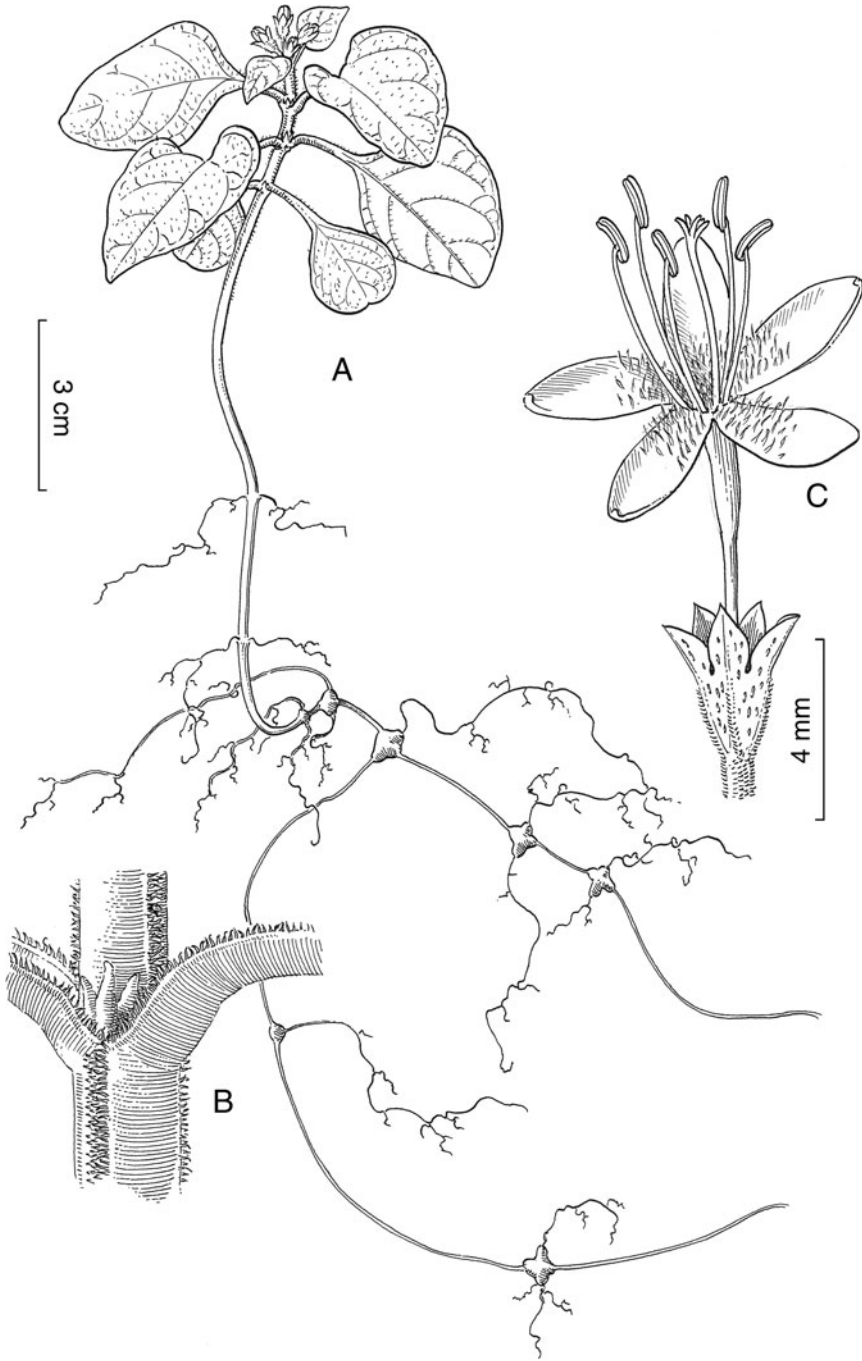


FIG. 1. *Pseudopyxis monilirhizoma* T.Chen. A, habit; B, node with stipule; C, flower.

– Type: China, Zhejiang, Longquan, Fengyang Shan, Shuikou, wet sites in rock gaps or on stream banks in forest understoreys, 1600 m, herbs erect, rhizomes moniliform at nodes, stems and leaves with foetid odour when crushed, flowers pink, young fruit small, 21 vii 1972, *Zhejiang Medicinal Flora Exp.* 2634 (holo A! (fl.); iso HZU! (fr.)).

Perennial herbs, with faint foetid odour when crushed. *Rhizomes* creeping, slender, sparsely branched; nodes enlarged, woody, hard, fusiform or irregular, 5–8 × 2–5 mm, with adventitious roots; internodes (0.5–)2–4.5 cm long. *Stem* erect, 7–10.5 cm long, with hairs in 2 rows. *Stipules* persistent, triangular, glabrescent, slightly fused with petiole at base, or unequally 3- or 5-toothed, teeth tipped by a colleter, middle lobe largest, c.0.5 mm long. *Leaves* in 3 or 4 opposite pairs, membranaceous, the lowest pair reduced and scale-like, generally largest leaves on middle one or two nodes at upper part of stem. *Petiole* 0.3–2 cm long, densely pubescent along midrib adaxially. *Leaf blade* deltoid-ovate, 0.8–4.5 × 0.6–3.5 cm, both surfaces sparsely pubescent, more densely so on midrib, ciliate at margin, midrib and 4 or 5 pairs of lateral veins slightly raised on both surfaces, base cuneate or truncate, attenuate into petiole, margin entire, apex acute or obtuse. *Flowers* June to August, 2 to 4 terminal and 1 or 2 in upper leaf axils. *Pedicel* 2–4 mm long, densely pubescent. *Calyx* campanulate, c.3 mm long, 5-ridged, densely pubescent along ridges, deeply 5-lobed; lobes ovate or ovate-lanceolate, c.2 mm long, elongated to 3–5 mm during fruit maturation, glabrous, apex acuminate. *Corolla* white or pink, salverform, 7–9 mm long, c.0.6–9(–13.5) mm in diameter, outside glabrous, inside pilose; tube cylindrical, filiform, c.5 mm long, slender, upper part dilated, 5-lobed; lobes lanceolate or narrowly oblong, c.4 mm long, apex acute, slightly hooked. *Stamens* 5, exserted; filaments filiform, glabrous; anthers linear, apex obtuse, opening by a vertical slit, c.1 mm long. *Ovary* 5-loculed with basal placentation, outside ribbed, ribs densely hairy; ovule 1 per locule; style filiform, exserted, c.12 cm long, glabrous, with (4 or)5 stigmatic lobes at apex. *Fruiting* August to October; capsule obdeltoid, with ovate or deltoid calyx lobes surrounding apex, thinly walled, opening by an apical lid, (1–)5-seeded. Immature *seeds* obovoid, enclosed by endocarp, black, c.1.2 mm long, with many white, longitudinal idioblasts containing raphides.

*Additional specimens examined.* CHINA. Zhejiang, Longquan, Fengyang Shan, Shuikou, whole plant with foetid odor when crushed, flowers white, corolla lobes hairy inside, 21 vi 1976, C.Z. Zheng 8037 (HZU); *ibid.*, wet sites or rock gaps in forest understoreys, 27°52'45"N, 119°10'09"E, 1450 m, small herbs, 15 vi 2007, T. Chen 07001 (A, E, SZG).

*Pseudopyxis depressa* is similar to *P. monilirhizoma* but distinct in having rhizomes slightly enlarged, woody, long claviform at internodes and, therefore, with nodes slightly constricted in appearance; stems uniformly hairy; terminal inflorescences often only 2-flowered; corolla glabrous or thinly pilose outside, hairy inside, tube narrowly funnel-shaped, 10–20 mm long, lobes ovate, 5–7 mm long, margin wavy or crinkly, apex faintly tripartite; style and anthers only in the uppermost part exserted in long-styled flowers; ovary not ribbed, densely hairy; fl. May–June.

*Pseudopyxis heterophylla* is similar to *P. monilirhizoma* but distinct in having rhizomes which are compact and frequently branched, dark brown, woody, stout, not enlarged or constricted, internodes usually shorter than 2 cm, nodes with stout, woody, dark brown roots; buds of the aerial stems rather closely spaced; stems up to c.30 cm tall; leaves 5- or 6-paired, the largest leaves in the mid-stem region; pedicels 3–4 mm, elongated to 4–6 mm (or more) in fruit, the terminal inflorescences conspicuously umbel-like; additional paired flowers or a solitary flower at the third node below the terminal inflorescence, and inflorescences several-flowered and distinctly pedunculate and bracteolate at the second node from the apex; corolla glabrous outside and inside; calyx lobes sometimes hairy on margins, considerably enlarged during fruit maturation to 5.5–6 mm, thin, conspicuously reticulate veined.

*Pseudopyxis* Miq. is a genus endemic to the Sino-Japanese Subregion of the East Asiatic Region (Wu, 1998). All allied genera within the tribe *Paederieae* DC., such as *Leptodermis* Wall., *Paederia* L., *Serissa* Comm. ex Juss. and *Spermadictyon* Roxb., are represented in this region. The description of the above new species is phytogeographically significant. It provides additional evidence for the Sino-Japanese pattern of disjunct distributions, which indicates that *Pseudopyxis* Miq. was derived before the late Tertiary when Japan became separate from the Asian continent. However, there is also the possibility that there was long distance dispersal of fruit by birds followed by differentiation in a more recent period of time.

#### ACKNOWLEDGEMENTS

I wish to acknowledge support from the Flora of China Project of the Missouri Botanical Garden and Chinese Academy of Sciences. I thank the curatorial staff of the Harvard University Herbaria (A, GH) for providing research facilities and access to specimens. I also thank Dr Anthony R. Brach (MO c/o A, GH), Dr David E. Boufford (A, GH) and Dr Gustavo A. Romero (A, GH) for helpful suggestions and comments on the manuscript, Dr Xiao-Feng Jin (HZU) for the loan of specimens, Dr Ching-I Peng and Ms Tsui-Ya Liu (HAST), Adele Smith (E), Sally Hinchcliffe (K) and Dr Sovanmoly Hul (P) for sending specimen images and information for this study, Mr Lixin Ye and Mr Shenglong Liu at Longquan for their assistance with field work, Mr Ping Ma for preparing the line drawing, and Mr Lawrence Springate (E) and an anonymous reviewer for their useful comments which helped to improve the manuscript.

#### REFERENCES

- FRANCHET, A. R. & SAVATIER, P. A. L. (1879). *Enumeratio Plantarum Japonicum* 2: 391.  
HANDEL-MAZZETTI, H. (1928). A revision of the Chinese species of *Lysimachia*, with a new system of the whole genus. *Notes Roy. Bot. Gard. Edinburgh* 16: 122.  
HOOKER, J. D. (1873). In: BENTHAM, G. & HOOKER, J. D. (eds) *Genera Plantarum* 2: 135. London: Reeve.

- 
- LUO, H. S. (1999). In: CHEN, W. C. (ed.) *Flora Reipublicae Popularis Sinicae* 71(2): 153–155. Beijing: Science Press.
- MAXIMOWICZ, C. J. (1873). Diagnoses plantarum novarum Japonia et Mandshuriae. Decas sexta decimal. *Bull. Acad. Imp. Sci. Saint-Pétersbourg*, sér. 3, 19: 286.
- MAXIMOWICZ, C. J. (1883). Diagnoses plantarum novarum asiaticarum, V. *Bull. Acad. Imp. Sci. Saint-Pétersbourg*, sér. 3, 29: 175.
- MIQUEL, F. A. W. (1867a). Prolusio Florae Japonicae. *Ann. Mus. Bot. Lugduno-Batavi* 3: 109.
- MIQUEL, F. A. W. (1867b). Prolusio Florae Japonicae. *Ann. Mus. Bot. Lugduno-Batavi* 3: 189.
- OHWI, J. (1953). *Flora of Japan*: 1088. Tokyo: Shibundo (in Japanese).
- OHWI, J. (1965). *Flora of Japan*: 828–829. Washington, D.C.: Smithsonian Institution.
- PETITMENGIN, M. (1907). Contributions a l'étude des Primulacées Sino-Japonaises. *Bull. Herb. Boissier*, sér. 2, 7: 530–531.
- PUFF, C. (1989a). Observations on the Japanese endemic *Pseudopyxis* (Rubiaceae-Paederieae). *Plant Species Biol.* 4: 131–144.
- PUFF, C. (1989b). The affinities and relationships of the Japanese endemic *Pseudopyxis* (Rubiaceae-Paederieae). *Plant Species Biol.* 4: 145–155.
- WU, C.-Y. (1998). Delineation and unique features of the Sino-Japanese floristic region. In: BOUFFORD, D. E. & OHBA, H. (eds) *Sino-Japanese Flora: Its Characteristics and Diversification*. University Museum, University of Tokyo, Bulletin Number 37: 1–35. Tokyo: Tokyo University Press.
- YAMAZAKI, T. (1993). In: IWATSUKI, K. (ed.) *Flora of Japan* 3a: 229. Tokyo: Kodansha, Ltd.
- ZHENG, C.-Z. (1981). *Pseudopyxis* Miq., a newly recorded genus of Rubiaceae from China. *J. Hangzhou Univ.* 8(1): 116–118.

*Received 26 February 2007; accepted for publication 5 July 2007*