



A revision of the genus *Notothylas* (Notothyladaceae, Anthocerotophyta) in China

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Abstract

The genus *Notothylas* in China contains four species. One new species, *Notothylas yunnanensis*, is described and illustrated. The new species is characterized by each proximal spore surface with a small central hollow, irregularly arranged, rectangular to quadrate epidermal cells of the capsule, and absence of a special dehiscence line in the capsule. A key to the species of *Notothylas* in China is provided.

Key words: China, hornworts, new species, *Notothylas yunnanensis*, Yunnan

Introduction

Hornworts, with about 200–250 species worldwide, represent a key group for understanding plant diversification and evolution (Qiu *et al.* 2006; Villarreal *et al.* 2010). The continuous discovery of new species in recent years (Garcia *et al.* 2012; Villarreal *et al.* 2012) and range extension of some rare taxa (Kirmaci *et al.* 2012; Peng & Zhu 2013) reveal that the global hornwort diversity, especially in Africa, Asia and America, is still poorly known. *Notothylas* Sullivant (1846: 74) is the fifth largest genus of approximately 12 genera of hornworts with 22 species at present (Villarreal *et al.* 2010, 2012). Most of these species occur in tropical to temperate regions, and the centre of diversity is in the Indian subcontinent where 11 species are known (Singh 2002).

The history of *Notothylas* in China began in 1934 when *N. orbicularis* (Schweinitz 1821: 23) Sullivant (1846: 75) was recorded in Taiwan by Horikawa (1934). Hasegawa (1979) studied the taxonomical status of Asian Anthocerotae, and confirmed that *Notothylas javanica* (Sande Lacoste 1856: 94) Gottsche (1858: 20) was present in Taiwan, China. In the same year, Hsu (1979) listed *Notothylas levieri* Schiffner *ex* Stephani (1917: 1021) in his checklist of bryophytes in China. Although several publications have contributed knowledge of the *Notothylas* flora in China (Rao *et al.* 1997; Piippo *et al.* 1998; Gao & Cao 2000; Lin 2000; Wu 2000; Gao & Lai 2003; Wu *et al.* 2006; Zhang & Wu 2006; Gao & Wu 2010; Zhang 2010; Wang *et al.* 2011), no taxonomic revision of the genus is available. Here we present a revision of *Notothylas* in China on the basis of herbarium specimens and fresh samples. Our studies reveal that there are four species of *Notothylas*, including a new species (*Notothylas yunnanensis*) with distinct spore morphology.

Generic description

Notothylas Sull., Amer. J. Sci. Arts 51: 74. 1846. Type species: *Notothylas orbicularis* (Schwein.) Sull. *ex* A.Gray
Plants prostrate, orbicular-suborbicular, dichotomously branched, forming isolated-confluent rosettes; lobes lacinate; thalli ecostate, solid, 3–9 cell layers thick, dorsal surface smooth, sometimes ridged or lamellate; dorsal epidermal cells rectangular to polygonal, chloroplasts 1 (–3) per cell, pyrenoid 1 per chloroplast or absent. *Nostoc* colonies occur irregularly on ventral side. Monoicous (in all Chinese species) or dioicous. Androecia scattered,

Habitat:—On moist soil under shaded conditions, loosely fixed with the substratum.

Distribution:—China [Jilin (Zhang & Wu 2006), Liaoning (Zhang & Wu 2006), Yunnan], India, Nepal, Thailand (Singh 2002; Lai *et al.* 2008).

Representative specimen examined:—CHINA. Yunnan: Kunming City, Xishan Park, on wet soil, 30 September 1956, *W.-X. Xu 210* (PE).

Notothylas orbicularis (Schwein.) Sull. ex A.Gray, Amer. J. Sci. Arts 1: 75. 1846.

≡ *Targionia orbicularis* Schwein., Sp. Fl. Amer. Crypt. 23: 1821. Type:—U.S.A. North Carolina, Forsyth, Salem, on moist earth, *L.D. Schweinitz s.n.* (holotype PH).

= *Notothylas japonica* Horik., Sci. Rep. Tohoku Imper. Univ. Ser. 4, 4: 425. 1929. Type:—JAPAN. Honshu. Pref. Fukushima. Prov. Rikuzen, *Y.H. Sendai 1340* (lectotype designated by Hasegawa (1979) HIRO).

Description:—Asthana & Srivastava (1991), Stieperaere & Matcham (2007).

Illustrations:—Hasegawa (1979, p. 22, fig. 2 a–g), Stieperaere & Matcham (2007, p. 4, fig. 1 a, b; fig. 2 a–d). *Notothylas orbicularis*, the most common species of *Notothylas*, is known from Africa, America, Asia and Europe. Its key characters are 1) dehiscence line of capsule consisting of 2(–3) rows of thick-walled cells, 2) presence of columella, 3) yellowish to brown spores with vermiculate surface, and 4) yellowish to dark brown pseudoelaters, with irregular helicoidal thickening bands.

Notothylas orbicularis is similar to *N. javanica*. For their differences, see *N. javanica*.

Habitat:—On moist soil at 500–2830 m.

Distribution:—China [Hunan (Piippo 1990; Rao *et al.* 1997; Gao & Cao 2000; Gao & Lai 2003 as *Notothylas orbicularis*), Jiangsu, Jilin, Liaoning, Sichuan, Taiwan (Piippo 1990; Zhang & Wu 2006 as *Notothylas japonica*; Lin 2000), Yunnan (Gao & Cao 2000 as *Notothylas japonica*; Zhang & Wu 2006 as *Notothylas japonica*), Zhejiang], Austria, Brazil, Congo, Czech Republic, Germany, Italy, Japan, Mexico, Thailand, Uganda, U.S.A. (Hasegawa 1979; Gradstein & Costa 2003; Stotler & Crandall-Stotler 2005; Frey *et al.* 2006; Ros *et al.* 2007; Stieperaere & Matcham 2007; Lai *et al.* 2008; Wigginton 2009; Kučera *et al.* 2012).

Representative specimens examined:—CHINA. Liaoning: Huanren Co., Laotudingzi National Nature Reserve, Tianqiaohegou, on soil, 500 m, 26 September 1986, *T. Cao & J.-Y. Feng 471B* (IFP); Jiangsu: Changshu City, Yushan Nature Reserve, Jianmen, on soil, 160 m, 11 October 1984, *D.-K. Li 017800* (SHM); Jilin: Linjiang City, mountain side of Maoershan, on wet soil, 500 m, 7 September 1963, *Q. Gao 7705* (IFP); Sichuan: Heishui Co., Dagu Glacier, Hongjun Lake, Tibetan Macaque Viewing Area, on soil, 32°12'37.79"N, 102°53'21.06"E, 2830 m, 24 August 2012, *R.-L. Zhu et al. 20120824-105B* (HSNU); Zhejiang: Shengzhou City, Guimen country, Jiexi village, Shijing, on soil near river, 4 October 2003, *R.-L. Zhu 20031004-1* (HSNU).

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