

Taxonomic study of the leafmining genus *Liocrobyla* Meyrick, 1916 from China (Lepidoptera, Gracillariidae, Ornixolinae) with a description of one new species

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Abstract

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Three species of the leafmining genus *Liocrobyla* Meyrick, 1916 from China are treated. *Liocrobyla indigofera* sp. n. feeding on the plant genus *Indigofera* is described as new to science. *Liocrobyla lobata* Kuroko, 1960 feeding on *Pueraria montana* var. *lobata* is newly recorded in China. *Lespedeza bicolor* is documented as a new host plant for *L. desmodiella* Kuroko, 1982. Photographs of adult habitus, male and female genitalia, as well as host plants, leaf mines and biology are provided.

Key Words

biology
distribution
host plant
new record
new taxon

Introduction

The genus *Liocrobyla* Meyrick, 1916 belongs to the subfamily Ornixolinae Kuznetsov & Baryshnikova, 2001, which was confirmed by a recent phylogenetic study (Kawahara et al. 2017). *Liocrobyla* is endemic to the Old World and hitherto includes eight species (De Prins and De Prins 2018), with six species known from Asia: *L. paraschista* Meyrick, 1916, *L. brachybotrys* Kuroko, 1960, *L. lobata* Kuroko, 1960, *L. desmodiella* Kuroko, 1982, *L. kumatai* Kuroko, 1982 and *L. minima* (Noreika, 1992) (Meyrick 1916, Kuroko 1960, Kuroko 1982, Noreika and Puplesis 1992), one from Solomon Islands: *L. saturata* Bradley, 1961 (Bradley 1961) and one from South Africa: *L. tephrosiae* Vári, 1961 (Vári 1961). Larvae of all species with known host associations are blotch leaf miners on various genera of the plant family Fabaceae (De Prins

and De Prins 2018). Only one species, *L. desmodiella* Kuroko, 1982, is currently known in China without host association (Bai and Li 2011).

The purpose of this paper is to report one new species and one species of *Liocrobyla* recorded for the first time from China and to document a new host for the known species. All the species are provided with information on their host plant associations, leaf mines, and morphology of adults and their genital diagnostic characters.

Methods

Leaves containing mines with larvae were placed in sealed plastic bags or rearing containers with moist cotton as previously described (Liu and Yan 2017). Pupae in rearing containers were placed outdoors to

overwinter and were transferred into the laboratory in early spring. All adults were collected by rearing from immature stages.

Adult photographs were taken with a Leica S6D stereo microscope. Genitalia were dissected and mounted according to the methods introduced by Li (2002), but stained with Eosin Y and/or Chlorazol Black. The illustrations were prepared by using a Leica DM1000 microscope and refined in PHOTOSHOP CS4 software. Photographs of host plant and mines were taken in the field using a Canon PowerShot G10 digital camera or a Canon EOS camera. Plant nomenclature follows APG (2016) and The Plant List (2013).

The types of the new species are deposited in the Zoological Collection, Shandong Normal University, Jinan, China (SDNU). Other specimens are deposited in the Insect Collection, Nankai University, Tianjin, China or SDNU as stated in the text.

Abbreviations

ELKU	Entomological Laboratory, Kyushu University, Fukuoka, Japan
NKU	Insect Collection, Nankai University, Tianjin, China
SDNU	Zoological Collection, Shandong Normal University, Jinan, China
TD	Type depository
TL	Type locality

Results

Liocrobyla desmodiella Kuroko, 1982

Figures 1, 5, 8, 11 and 13–17

Liocrobyla paraschista Meyrick: Kuroko, 1960: 2. Misidentification.
Liocrobyla desmodiella Kuroko, 1982: 185; Ermolaev 1987: 370; Bai and Li 2011: 480. TL: Japan (Kyushu). TD: ELKU.

Diagnosis. This species resembles *Liocrobyla lobata* Kuroko, 1960 in the general appearance of the forewing patterns, but can be distinguished by the blackish-grey forewing ground colour, which is brownish-grey in *L. lobata*. In the male genitalia, this species can be separated by the valva having a remarkable concavity at distal 1/4 and bearing a small ventro-apical hook; in *L. lobata*, the valva is almost parallel-sided and bears straight spines. The ninth tergite of the male *L. desmodiella* bears a pair of sclerotized lines originated from the middle of the posterior margin, which is absent in *L. lobata*.

Material examined. China: Tianjin: 3♂, 1♀, Mt. Baxian, Ji County, 40.180°N, 117.550°E, 400 m, 2014.vi.24, leaf mines collected on *Lespedeza bicolor*, emerged 2014.vii.09, leg. Tengting Liu, genitalia slide nos. LTT12611♂, LTT12612♀ (NKU).

Adult (Fig. 1). Forewing length 3.0–3.5 mm. Head white on frons and face, with a tuft of black scales at base of antenna, vertex white with a black median line. Maxillary palpus black, about 1/3 length of labial palpus. Labial palpus white, black on distal part of second segment, with a mid-ventral black spot on third segment. Antennae black on scape, yellowish-fuscous and with black rings on other segments. Thorax yellowish-fuscous, tegula blackish grey. Forewing ground colour blackish grey, a greyish-fuscous stripe from costal 1/3 to 1/2, then curved downwards by white colour to near distal end of cell; two white stripes on distal 1/3 and 2/5 on costa obliquely to middle of wing; two longitudinal striae near apex, two longer striae near lower angle of cell; an yellowish-fuscous stripe along dorsum from base to tornus, with three to four black spots above; cilia white with two black lines around apex, dark grey on dorsum. Abdomen: blackish grey dorsally, white ventrally.

The forewing pattern of the specimens reared from *Lespedeza bicolor* is congruent to the Japanese specimens reared from *L. cyrtobotrya* (Kuroko 1960).

Male genitalia (Figs 5 and 8). Tegumen narrowed towards apex, with distal 1/6 triangular. Vinculum with a small round protrusion anteriorly. Valva concave at distal 1/4 and bearing a small ventro-apical hook and some 12 smaller teeth below. Phallus shorter than valva. The ninth tergite more or less semicircular, having paired sclerotized lines originated from the middle of the posterior margin.

Female genitalia (Fig. 11). Seventh sternite sharply projected postero-laterally, thus U-shaped on posterior margin. Antrum sclerotized short tube. Ductus bursae membranous, densely covered with granules on inner wall, about twice the length of antrum; ductus seminalis originated from ductus bursae near antrum, covered with dense teeth on opening, a sclerotized line extending from ductus bursae to ductus seminalis then curved back to near its beginning. Corpus bursae a membranous bag, about twice the length of ductus bursae.

Biology (Figs 13–17). The larval behaviour in the mine on *L. bicolor* is similar to that on *L. cyrtobotrya* as described by Kuroko (1960). Leaf mines placed on upper side of leaflet and stretched across midrib; a black tunnel made of silk and frass aside midrib from upper to lower side of leaflet, covered by dry leaflet epidermis on lower side opening. One mine per leaflet.

Host plants. Fabaceae: *Lespedeza bicolor* Turcz. in China, **new record**; *L. cyrtobotrya* Miq., *Desmodium oldhamii* Oliv., *Ohwia caudata* (Thunb.) H. Ohashi and *Hylodesmum podocarpum* subsp. *oxyphyllum* (DC.) H. Ohashi & R.R. Mill in Japan (Kuroko 1960, The Plant List 2013; see remarks for the nomenclature changes of the host plants).



Figures 1–4. Adult of *Liocrobyla* spp. **1.** *L. desmodiella*; **2.** *L. lobata*; **3)** *L. indigofera* sp. n., male, holotype, before dissection; **4.** *L. indigofera* sp. n., female, paratype, before dissection. Scale bars: 2.0 mm.

Distribution. China: Tianjin (new record); Sichuan and Zhejiang (Bai and Li 2011), Japan (Kuroko 1982), Russia Far East (Ermolaev 1987).

Remarks. The host plant *Lespedeza bicolor* was newly recorded for this species. Kuroko (1982) stated in Japanese that the species identified as *Liocrobyla paraschista* Meyrick, 1916 in Kuroko (1960) was a misidentification and he named it as a new species, *L. desmodiella* Kuroko, 1982. Because of the misidentification of the moth, the host plants recorded in Japan, *L. cyrtobotrya*, *D. oldhamii*, *Desmodium racemosum* (Thunb.) DC. and *D. caudatum* (Thunb.) DC., originally associated with *Liocrobyla paraschista* by Kuroko (1960), are actually belonging to *L. desmodiella*. Ermolaev (1987) recorded *L. desmodiella* in the Russian Far East but just followed Kuroko (1960) by listing its host plants, thus the host plants of this species in Russia are still of uncertainty. Moreover, *D. racemosum* and *D. caudatum* have been treated as synonyms of *Hylodesmum podocarpum* subsp. *oxyphyllum* and *Ohwia caudata* in The Plant List (2013), respectively.

Liocrobyla lobata Kuroko, 1960

Figures 2, 6, 9 and 18–22

Liocrobyla lobata Kuroko, 1960: 5; Kuroko 1982: 184; Park 1983: 62. TL: Japan (Kyushu). TD: ELKU.

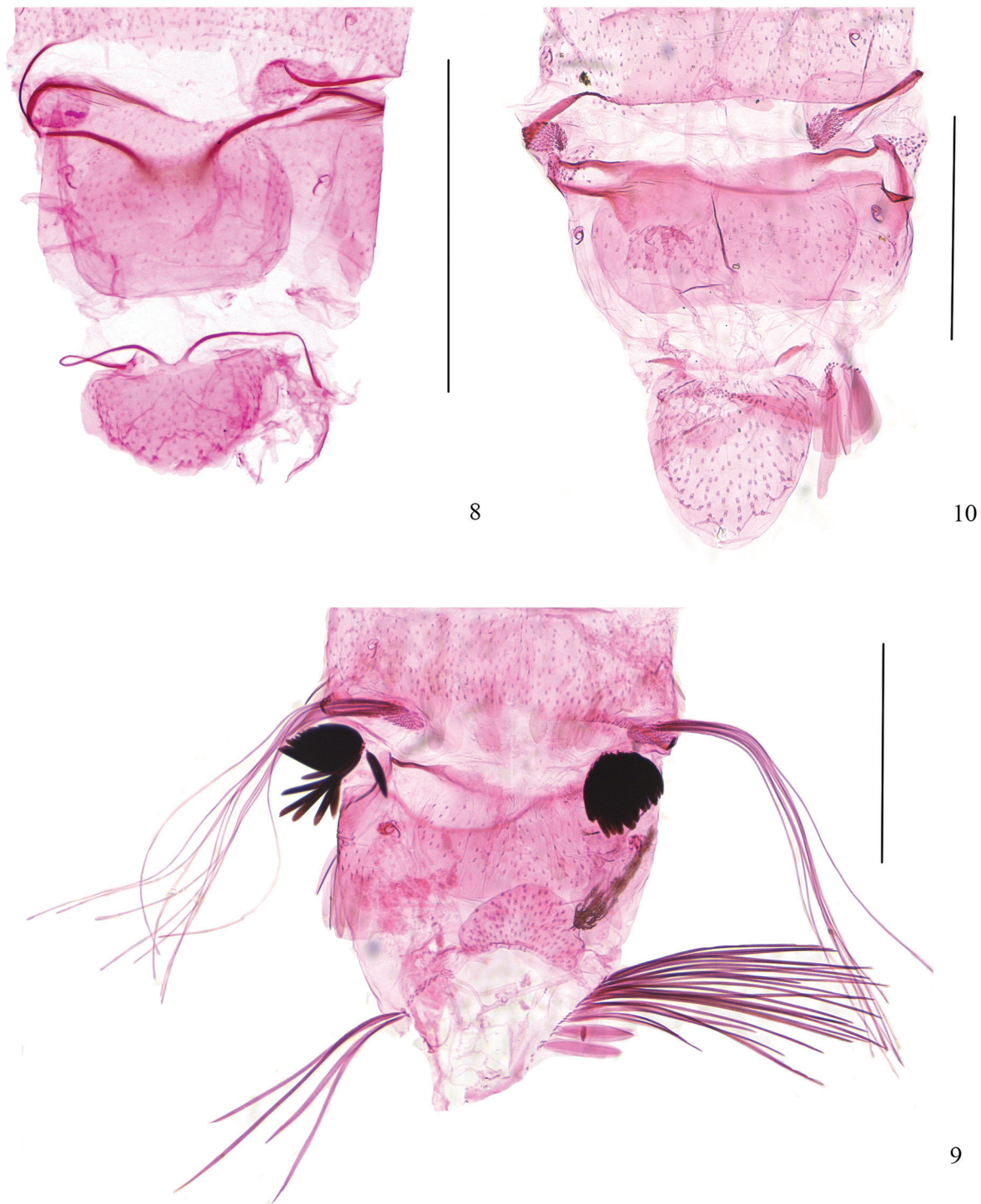
Diagnosis. See *Liocrobyla desmodiella* for detail.

Material examined. China: Shandong Province: 4♂, Mt. Kunyu National Nature Reserve, 37.292°N, 121.740°E, 400 m, Yantai City, 2017.vii.18, leaf mines collected on *Pueraria montana* var. *lobata*, emerged vii.29, leg. Tengting Liu & Zhenquan Gao, genitalia slide nos. LIU0028, registered nos. SDNU.YT17170702.3–6 (SDNU).

Adult (Fig. 2). Head white on frons and face, tinged blackish fuscous on base of antennae, vertex white with a brownish-grey median line. Maxillary palpus black mixed with white, about 1/4 length of labial palpus. Labial palpus white, black on distal part of second segment, with a mid-lateral black spot on third segment. Antennae



Figures 5–7. Male genitalia of *Liocrobyla* spp. **5.** *L. desmodiella*, slide no. LTT12611 (NKU); **6.** *L. lobata*, slide no. LIU0028; **7.** *L. indigofera* sp. n., slide no. LIU0030, holotype. Scale bars: 0.2 mm.



Figures 8–10. Male pregenital structures of *Liocrobyla* spp. **8.** *L. desmodiella*, slide no. LTT12611 (NKU); **9.** *L. lobata*, slide no. LIU0028; **10.** *L. indigofera* sp. n., holotype, slide no. LIU0030. Scale bars: 0.5 mm.

with scape white on front and black dorsally, other segments brownish grey with darker rings. Thorax yellowish fuscous, tegula brownish grey. Forewing ground colour brownish grey, darker towards costa, a white stripe from costal 1/3 to before 1/2, then curved downwards to near tornus; two white stripes beyond distal 1/3 and 2/5 on costa obliquely to middle of wing; two longitudinal striae near apex, with the costal one indistinct, one white spot

on tornus; a white stripe along dorsum from base to tornus, partially edged with black scales and largely covered by brownish-fuscous scales on dorsum; cilia white with two black lines around apex, grey on dorsum. Abdomen: light fuscous dorsally, white ventrally.

Male genitalia (Figs 6 and 9). Tegumen slender, almost same in width. Vinculum narrowly triangular. Valva almost



Figures 11–12. Female genitalia of *Liocrobyla* spp. **11.** *L. desmodiella*, slide no. LTT12612 (NKU); **12.** *L. indigofera* sp. n., slide no. LIU0029, paratype. Scale bars: 0.5 mm.

identical in width, bears some 15 minute teeth along dorsal margin and two longer ventro-apical spines. Phallus shorter than valva. Paired clusters of slender scales and black short scales on membrane between seventh and eighth terga. Ninth segment with tergite heart-shaped, a line of slender scales along lateral side (Fig. 9).

Biology (Figs 18–22). Mines not restricted to a fixed placement, with apparent digital galleries. A white tunnel

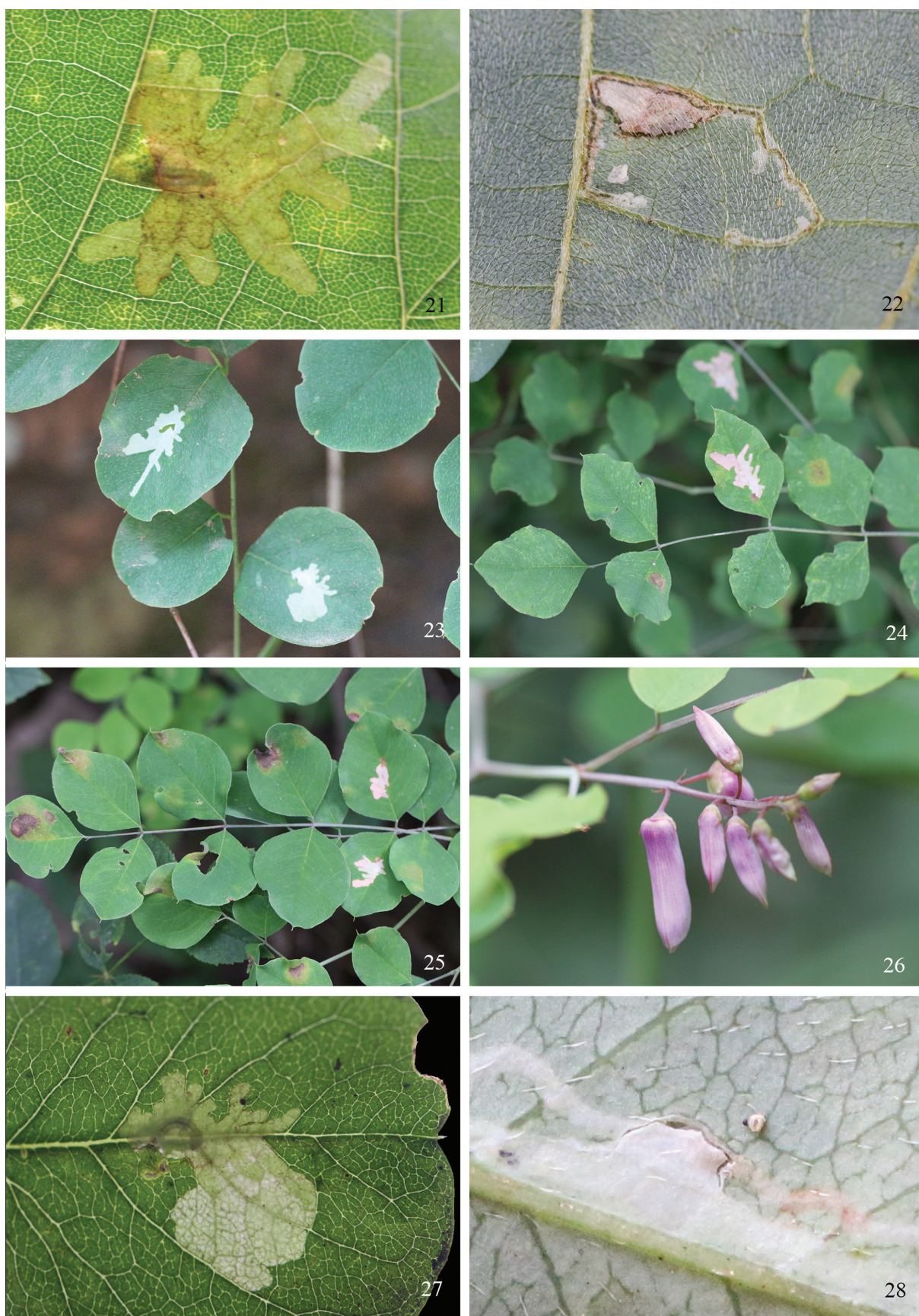
made of silk only from upper to lower side of leaflet. Often more than one mine per leaf (Fig. 19).

Host plants. Fabaceae: *Pueraria montana* var. *lobata* (Willd.) Sanjappa & Pradeep.

Distribution. China: Shandong (**new record**), Japan (Kuroko 1960), Korea (Park 1983).



Figures 13–20. Biology of *Liocrobyla* spp. 13–17. *L. desmodiella*, 13. host plant, *Lespedeza bicolor*; 14. leafmine; 15. frass opening on upper side of leaf; 16. frass opening on lower side of leaf; 17. cocoon and pupal exuviae; 18–20. *L. lobata*, 18. host plant, *Pueraria montana* var. *lobata*; 19. leafmines; 20. an opened mine with a larva exposed.



Figures 21–28. Host plants, leafmines and biology of *Liocrobyla* spp. 21–22, *L. lobata*, 21. leafmine with an alive larva; 22. frass opening on lower side of leaf; 23–28. *L. indigofera* sp. n., 23. leafmines each on a leaf of *Indigofera kirilowii*; 24–25. leafmines on *I. tinctoria*; 26. raceme of *I. tinctoria*; 27. leafmine with a living larva, identical mine to the lower-right mine in Fig. 23; 28. frass opening on lower side of leaf, identical mine to Fig. 27.

Remarks. *Pueraria lobata* has been treated as a synonym of *Pueraria montana* var. *lobata* (Willd.) Sanjappa & Pradeep in The Plant List (2013).

Liocrobyla indigofera sp. n.

<http://zoobank.org/2D79B9E2-C197-4377-B9F0-43F507168183>

Figures 3, 4, 7, 10, 12 and 23–28

Diagnosis. The new species resembles *L. lobata* in the male genitalia, but can be separated by the phallus longer than the valva and the minute cornutus; in *L. lobata*, the phallus is shorter than valva and the cornutus is more than 1/12 length of the phallus. In *L. indigofera*, the head is dark grey and the forewing ground colour is blackish fuscous, while in *L. lobata*, the head is white and the forewing ground colour is brownish grey.

Type material. **Holotype**, ♂, China: Shandong Province: Mt. Laoshan, 36.204°N, 120.609°E, 400 m, Qingdao City, 2017.vii.01, leafmine collected on *Indigofera kirilowii*, pupated vii.05, emerged vii.18, leg. Tengteng Liu & Zhenquan Gao, genitalia slide no. LIU0030♂, registered no. SDNU.QD170710.2 (SDNU); **Paratype**: 1♀, genitalia slide no. LIU0029♀, registered no. SDNU.QD170710.1, other data same as holotype (SDNU).

Other material. Leaf mines collected on *Indigofera tinctoria* Linn., Mt. Laoshan, 120.609°E, 36.204°N, 400 m, Qingdao City, 2017.vii.01, leg. Tengteng Liu.

Adult (Figs 3 and 4). Forewing length 3.0 mm. Head with frons white, vertex dark grey with a black median line. Maxillary palpus black, pointed apically, about 1/4 length of labial palpus. Labial palpus white, with black rings at middle and before apex. Antennae with scape dark dorsally, white ventrally, other segments dark with black rings. Thorax yellowish gray, with a dark central line, tegula blackish-fuscous; legs white with blackish-fuscous rings. Forewing blackish-fuscous, fuscous along dorsum, stripes and spots white; a sinuous stripe from costal 1/3 to apex of disc divided into three or occasionally two parts (which is continuous in *L. lobata*); one stria at costal 2/3; a transverse outwards arched stripe at 4/5, separated at middle, with violet reflection; two spots above the fuscous stripe on dorsum, with outer one larger; two minute spots near apex; cilia white, with three black lines. Hind wing blackish-grey. Abdomen: blackish-grey dorsally, silvery white ventrally.

Male genitalia (Figs 7 and 10). Tegumen weakly sclerotized. Valva more or less rectangular, divided by a sclerotized ridge, dorsal part more sclerotized than costal one; costal part densely covered with setae apically, dorsal part with two long digital processes apically and one or two minute processes below apex. Vinculum narrowly triangular. Phallus longer than valva, curved beyond middle, pointed apically, vesica roughened, with a minute inversed cornutus. Ninth tergite more or less oval (Fig. 10).

Female genitalia (Fig. 12). Posterior and anterior apophyses triangular, about as long as eighth tergite. Antrum sclerotized. Ductus bursae about twice the length of seventh segment, sinuous at middle, strongly sclerotized ventrally, membranous dorsally; ductus seminalis originated from ductus bursae near antrum, sclerotized and sinuous basally. Corpus bursae oval, membranous.

Biology (Figs 23–28). Larval mine is a white blotch, with several digital galleries, always located in the middle of the upper side of a leaflet (Figs 23 and 27). A frass opening on the lower side of the leaflet always locates close to the midrib, covered by a piece of white dry leaf tissue (Fig. 28). A single mine per leaflet (Figs 23–25).

Host plants. Fabaceae: *Indigofera kirilowii* Palib., *I. tinctoria* L.

Distribution. China (Shandong).

Etymology. The specific name is derived from the genus name of the host plants.

Discussion

Individual species of leaf miners, at least in many groups of Lepidoptera, are typically host-specific at a plant genus or family level (Regier et al. 2015), a fact which greatly facilitates the process of identification of a moth specimen with host association. The process involves two main parts: recognizing the family or genus of a moth specimen and identifying the host plant. The first part is generally easier for a lepidopterist than identifying a plant species. Besides the great differences between disciplines that results in this difficulty, botanists are undertaking revisions for the nomenclature of plants (The Plant List 2013), thus making the difficulty even greater.

Host plant specimens are recommended to be identified by a botany taxonomist and the nomenclature of the host plant is recommended to be checked in The Plant List which may be the most comprehensive single information resource covering all plants (The Plant List 2013). The nomenclature of host plant names derived from the old literature have possibly changed, such as the host plant names of *Liocrobyla desmodiella* and *L. lobata* in the present study. The Plant List could thus be treated as advisory and a lepidopterist should check the nomenclature of these plant names derived from old literature.

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