



A review of *Organopoda* Hampson, 1893 (Lepidoptera, Geometridae) from China, with description of three new species

LE CUI^{1,2}, DAYONG XUE¹ & NAN JIANG^{1,3}

¹Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing 100101, China

²University of Chinese Academy of Sciences, Shijingshan District, Beijing 100049, China

³Corresponding author. E-mail: jiangn@ioz.ac.cn

Abstract

The Chinese species of the genus *Organopoda* Hampson, 1893 are reviewed: seven species are reported from China. Three new species, *O. acutula* **sp. nov.**, *O. deltaformis* **sp. nov.** and *O. megiste* **sp. nov.** are described. Diagnostic characters of all Chinese species are provided. External features and genitalia are depicted.

Key words: diagnosis, Rhodostrophiini, Sterrhinae, taxonomy

Introduction

The genus *Organopoda* Hampson, 1893 was established based on the type species *Anisodes carnearia* Walker, 1861, which was cited as *carnearia* Moore (an incorrect authorship) by Hampson (1893). The genus *Organopoda* is currently treated in the tribe Rhodostrophiini within the subfamily Sterrhinae, as it has some typical tribal features: presence of the hair pencil on the male hindtibia; forewing with two areoles; slender uncus with inflated and setose apex; well-developed gnathos; signum with sclerotized area of spurs (Holloway 1997; Hausmann 2004). *Organopoda* species are mainly distributed in the Palearctic, Oriental and Australian regions (Prout 1920–1941; Holloway 1997; Parsons *et al.* 1999; Choi 2009). Prout (1920–1941) recorded 13 species of *Organopoda* from the Palearctic region, and distinguished the genus from *Discoglypha* Warren, 1896. Holloway (1997) provided a diagnosis for the genus *Organopoda* and covered four species from Borneo. Up to the present, the genus *Organopoda* contains 12 species and eight subspecies all around the world including three species recorded in China (Prout 1920–1941; Holloway 1997; Parsons *et al.* 1999; Scoble & Hausmann 2007; Han & Xue 2002).

As a result of study of material obtained from recent expeditions and re-examination of collection materials from China, we have discovered several new species of Sterrhinae (Cui *et al.* 2018a, 2018b, 2019a, 2019b; Xue *et al.* 2018). The purpose of this paper is to provide a review of Chinese *Organopoda* species, and to describe three new species of this genus from China, namely *O. acutula* **sp. nov.**, *O. deltaformis* **sp. nov.** and *O. megiste* **sp. nov.**. Additionally we record *O. brevipalpis* Prout, 1926 for the first time from China, and provide diagnostic characters, illustrations of external features and genitalia of all Chinese species.

Materials and methods

Specimens of *Organopoda* were obtained from the Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZCAS). Other cited museums where materials are deposited are the Natural History Museum, London, UK (NHMUK) and Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK). Terminology for the wing venation follows the Comstock-Needham System (Comstock 1918) as adopted for Geometridae by Scoble (1992) and Hausmann (2001). Terminology for the genitalia structures follows Pierce (1914, reprint 1976), Klots (1970) and Nichols (1989). Procedures for the dissection and preparation of genitalia followed the standard of the

Lepidoptera section of the Natural History Museum, London, UK. Photographs of moths were taken with a digital camera. Composite images were generated using Auto-Montage software version 5.03.0061 (Synoptics Ltd). The plates were compiled using Adobe Photoshop software 7.0. Ink (Adobe Systems Software Ireland Ltd).

Taxonomy

Organopoda Hampson, 1893

Organopoda Hampson, 1893, *Illust. typical Specimens Lepid. Heterocera Colln Br. Mus.*, 9: 38, 147. Type species: *Anisodes carnearia* Walker, 1861.

Generic characters. *Head.* Antennae weakly serrate in male and filiform in female, shaft scattered with short cilia, longer in male. Frons not protruding. Labial palpi usually elongate, except in *O. atrisparsaria* Wehrli, 1924 and *O. brevipalpis* Prout, 1926. Hindtibia in male possess with a cluster of long bristles at anterior part and a pair of spurs (one long and narrow, and the other black with short yellowish hairs, very dilated and scoop-shaped); hind tarsus with first segment very dilated and scoop-shaped, and fringed with short hairs (fig. 17); hindtibia in female with two pairs of spurs. *Venation.* Forewing with two areoles; veins R_1 and R_5 arising before apex of the angle of the second areole; veins R_{2+4} stalked arising from apex of the angle of the second areole; hindwing with veins R_s and M_1 short stalked, veins M_3 and CuA_1 separate. Forewing with apex slightly pointed, outer margin slightly arched; hindwing with apex rounded. Wings with transverse lines often serrate, sometimes indistinct and spot-like on veins; discal spots rounded, sometimes with pale scales centrally.

Male genitalia. Uncus long and narrow, apical half usually dilated, with two protrusions and long bristles on ventral side, rounded at tip. Socii absent. Gnathos well developed. Valva broad, often with projections from costa or sacculus; saccus small, usually protruding. Aedeagus usually thick, terminally pointed, sometimes with a spur subapically; vesica without cornutus. Sternite 8 usually weakly concave at middle of posterior margin.

Female genitalia. Papillae anales broad, usually stout and short. Lamella postvaginalis well developed. Lamella antevaginalis connected with the latter. Ductus bursae long and narrow with a sclerotized hood-like structure associated with ostium. Ostium small and strongly sclerotized. Ductus seminalis usually arising from posterior part of ductus bursae. Corpus bursae very large and elongate, membranous, sometimes scobinate with small spurs on posterior surface; signum composed of two adjacent rounded depressions covered with small spines on surface. Sternite 7 usually sclerotized and containing depressions or protrusions.

Diagnosis. The genus is similar to *Discoglypha* Warren, 1896, but it is different in the following characters: the labial palpi in *Organopoda* are usually longer than *Discoglypha*; the male hindtibia has a pair of spurs in *Organopoda*, but only one spur in *Discoglypha*; the discal spot of the hindwing is black ringed and pale-centered in *Organopoda*, while it is yellow and irregular in *Discoglypha*. In the male genitalia, the aedeagus in *Discoglypha* often contains strongly sclerotized structures, while it does not have similar structures in *Organopoda*. In the female genitalia, the lamella postvaginalis in *Organopoda* is usually well developed and connected with the lamella antevaginalis, while it is not developed in *Discoglypha*.

Distribution. The Palaearctic, Oriental, and Australian regions.

Host-plant. Larvae have been recorded on *Machilus* (Lauraceae) (Holloway 1997).

Organopoda carnearia (Walker, 1861)

Figs 1, 10, 18

Anisodes? *carnearia* Walker, 1861, *List Specimens lepid. Insects Colln Br. Mus.*, 22: 644. Holotype ♀, Ceylon [Sri Lanka] (NHMUK).

Organopoda carnearia: Prout, 1934, in Strand, *Lepid. Cata.*, 61: 23.

Material examined. **CHINA: Hubei:** 1♂, Xingshan, Xiaohekou, 700 m, 11.V.1994, coll. Li Wenzhu; 1♂1♀, Xingshan, Longmenhe, 1350 m, 14.VII.1993, coll. Song Shimei. **Hunan:** 1♀, Sangzhi, Badagong Shan, Xiaozhuangping, 1420 m, 14.VI.2015, coll. Yao Jian & Zhao Kaidong. **Fujian:** 1♀, Jiangle, Longqi Shan, 790 m, 11.V.1991, coll.

Yao Jian. **Guangxi**: 1♂, Jinxiu, Luoxiang, 200 m, 15.V.1999, coll. Han Hongxiang; 1♀, Fulong, 500 m, 24.V.1999, coll. Zhang Yanzhou. **Hainan**: 4♂4♀, Lingshui, Diaoluo Shan, 920–946 m, 3.V.2007, 29–31.III.2008, coll. Lang Songyun (slide no. 3450); 1♂, Baisha, Yinggeling, 434 m, 3–4.XII.2007, coll. Li Jing; 1♀, Jianfengling, 20.I.1982, coll. Liu Yuanfu; 1♀, Tianchi, 900 m, 13.IV.1980, coll. Pu Fuji; 2♂, Yinggeling natural reserve, 950–1100 m, 27.VIII–12.IX.2005, coll. Liu Chunxiang; 1♂, Ledong, Jianfengling, Tianchi, 828 m, 20.V.2009, coll. Yan Keji; 1♀, Baisha, Nankai, Nanmaola, 1261 m, 10.V.2009, coll. Yan Keji; 1♀, Ledong, Jianfengling, Yulingu, 707 m, 21.V.2009, coll. Yan Keji (slide no. 3451); 1♀, Qiongzong, Limuling, Qijia, 657 m, 6–7.IV.2010, coll. Jiang Nan. **Guangxi**: 1♂, Jinxiu, Luoxiang, 200m, 15.V.1999. **Sichuan**: 1♂, Emei Shan, Qingyinge, 800–1000 m, 18.IV.1957, coll. Lu Youcai. **Yunnan**: 2♂, Baoshan, Baihualing, 1520 m, 11–13.VIII.2007, coll. Xue Dayong & Wu Chunguang; 1♂, Tengchong, Heinitang, 1930 m, 28–30.V.1992, coll. Xue Dayong. **Tibet**: 1♂, Zayü, Xia Zayü, 1445 m, 9.VIII.2014, coll. Cheng Rui & Cui Le (slide no. 4568). All in IZCAS.

Diagnosis. *O. carnearia*, *O. acutula*, *O. annulifera* (Butler, 1889) and *O. deltaformis*, share similar wing patterns. They differ from *O. atrisparsaria* and *O. megiste* by the paler medial line and the smaller discal spots of the fore wing respectively. The discal spots of the hindwing in *O. carnearia* and *O. annulifera* are larger than those in the other two species, and the discal spots of the forewing in *O. carnearia* are smaller than those in *O. annulifera*. The male genitalia of *O. carnearia* are different from other congeners by the following characters: the ventral surface of the costa has a broad plate-like process at the basal half and is covered with several short setae terminally; the sacculus is very broad and forms a quadrate process with small spurs terminally at the base; the aedeagus does not have a spur terminally. The female genitalia of *O. carnearia* are different in the rounded lamella antevaginalis with a pair of spur-like lateral processes.

Distribution. China (Hubei, Hunan, Fujian, Guangxi, Taiwan, Hainan, Guangxi, Sichuan, Yunnan, Tibet), Japan, Korean peninsula, the Philippines, India, Sri Lanka, Indonesia.

Remarks. The nominate subspecies *O. carnearia carnearia* is distributed in China.

Organopoda acutula sp. nov.

Figs 2, 11, 19

Type material. Holotype, ♂, **CHINA: Gansu**: Wenxian, VI–IX.2002, coll. Wang Hongjian. Paratypes: **Gansu**: 1♀, same as holotype (slide no. 4418); 1♀, Bikou, Bifenggou, 720 m, 8–10.VIII.2016, coll. Cheng Rui & Jiang Shan. **Hunan**: 1♂, Sangzhi, Bamaoxi, Shuitiannan, 370 m, 16.VIII.2009, coll. Wei Zhongmin; 1♀, Sangzhi, Badagong Shan, Xiaozhuangping, 14.VI.2015, coll. Zhao Kaidong; 1♂, Zhangjiajie, Wulingyuanqu, Wenfeng, 10.VI.2015, coll. Yao Jian & Zhao Kaidong. **Sichuan**: 2♂, Emei Shan, Qingyin'ge, 800–1000 m, 26.IV.1957, 16.VII.1957, coll. Zhu Fuxing (slide no. 3463). All specimens of type series deposited in IZCAS.

Description. *Head.* Antennae weakly serrate in male and filiform in female, shaft scattered with short cilia; dorsal side covered with white scales at base. Frons reddish brown, not protruding. Labial palpi reddish brown on dorsal side and yellow on ventral side, third segment about a half-length of second segment, extending beyond frons. Vertex pale white.

Thorax. Patagia deep yellowish brown. Tegulae and thorax greyish brown. Forewing length: male 15–16 mm, female 14–15 mm. Wing colour deep yellowish brown, darker on costal area of forewing; transverse lines serrate. Forewing with antemedial line brown and indistinct; discal spot small and black ringed; medial line deep brown, incurved below vein CuA_1 , indistinct; postmedial line sometimes indistinct and forming black spots on veins, nearly parallel with medial line; terminal line black and triangular between veins. Hindwing with discal spot black ringed and white-centered, and larger than that of forewing; medial line blackish brown, curved outwards centrally; postmedial line, terminal line and fringes similar to those of forewing. Underside. Pale yellowish brown; transverse lines similar to those of upperside.

Male genitalia (Fig. 11). Uncus in apical half broadened with two small processes on ventral side. Gnathos triangular, apically acute. Valva forming a small rounded process at apex; costa produced outwards; a short and digitiform process present on inner side of costa; sacculus with a stout and digitiform process near basal part. Saccus small. Aedeagus narrow and acute at apex, with a small spur subapically.

Female genitalia (Fig. 19). Lamella postvaginalis almost triangular. Lamella antevaginalis narrow, plate-like, with dentate lateral margins. Ostium small and strongly sclerotized. Ductus bursae narrow and membranous, with a

strongly sclerotized hood-like structure associated with ostium. Ductus seminalis usually arising from posterior part of ductus bursae. Corpus bursae long and bag-like, posterior part scattered with spurs on surface; signum oval, narrow centrally. Sternite 7 with a pair of wrinkled and rounded depressions on sides, weakly sclerotized and scabrous on surface.

Diagnosis. The discal spot of the hindwing is smaller than in *O. carnearia* and *O. annulifera*, and is less rounded than in *O. deltaformis*. In the male genitalia, *O. annulifera* and *O. acutula* have similar digitiform saccular processes. However, *O. acutula* differs from *O. annulifera* by the following characters: the gnathos is triangular in *O. acutula*, while it is digitiform in *O. annulifera*; the apex of the valva forms a small rounded process in *O. acutula*, but is concave in *O. annulifera*. In the female genitalia, *O. acutula* and *O. deltaformis* have some similar characters: the lamella postvaginalis protrudes in the middle of the posterior margin; the lamella antevaginalis is broad and plate-like with dentate lateral margins. But, *O. acutula* differs from *O. deltaformis* by the following characters: the middle part of the posterior margin of the lamella postvaginalis is less protruding in *O. acutula* than in *O. deltaformis*; the signum is smaller in *O. acutula* than in *O. deltaformis*.

Distribution. China (Gansu, Hunan, Sichuan).

Etymology. The species is named on the basis of the Latin word “*acutulus*”, which refers to the acute shape of the gnathos.

***Organopoda annulifera* (Butler, 1889)**

Figs 3, 12

Anisodes annulifera Butler, 1889, *Illustr. typical Specimens Lepid. Heterocera Colln Br. Mus.*, 7: 22, 107, pl. 136, fig. 10. Syntypes, India: Kangra district, Dharmasala (NHMUK).

Organopoda annulifera signifera Prout, 1938, in Seitz, *Macrolepid. World*, 12: 147, pl. 16: a. Syntypes, India: Khasi Hills (NHMUK).

Material examined. CHINA: Hubei: 1♂, Xingshan, Longmenhe, 1300 m, 9.V.1994, coll. Li Wenzhu. **Fujian:** 1♂, Meihua Shan, Huyuan, 1267 m, 19.VII.2013, coll. Pan Xiaodan. **Sichuan:** 6♂, Emei Shan, Qingyin'ge, 800–1000 m, 17–28.IV.1957, 4.VII.1957, coll. Zhu Fuxing & Wang Zongyuan (slide no, 3452). **Guizhou:** 1♂, Libo, Weng'ang, 810 m, 23–26.VII.2015, coll. Jiang Nan (slide no, 4569). All in IZCAS.

Diagnosis. See the diagnosis of *O. carnearia* and *O. acutula*. The female genitalia are unknown.

Distribution. China (Hubei, Fujian, Guangdong, Sichuan, Guizhou), India.

***Organopoda deltaformis* sp. nov.**

Figs 4, 13, 20

Organopoda carnearia sensu Han & Xue, 2002, in Huang, *Insects of Hainan Island*: 550. (Misidentification)

Type material. Holotype, ♂, **CHINA: Hainan:** Baisha, Nankai, Nanmaola, 1261 m, 12–14.V.2009, coll. Yan Keji. Paratypes: **Hainan:** 1♂1♀, same to holotype (slide no. 3460); 1♂3♀, Jianfengling, 30.VII.1981, 14.IV.1983, 4.V.1983, 21.XII.1983, coll. Gu Maobin & Liu Yuanfu (slide no. 3461); 1♂, Jianfengling, Tianchi, 828 m, 1–5.V.2007, coll. Chen Fuqiang; 2♀, Lingshui, Diaoluo Shan, 920 m, 29.III.2008, coll. Lang Songyun; 1♀, Bawangling, Dong'er linchang, 1015 m, 8–10.V.2007, coll. Chen Fuqiang; 1♂1♀, Wuzhi Shan, Shuiman, 730–900 m, 8, 11.V.2007, coll. Chen Fuqiang; 1♂, Ledong, Jianfengling, Tianchi, 808 m, 18.V.2009, coll. Chen Fuqiang; 1♀, Qiongzong, Limu Shan, Qijia, 645 m, 3–4.IV.2010, coll. Jiang Nan. **Sichuan:** 1♂, Tengchong, Qushi daba, 1823 m, 5.VIII.2013, coll. Liu Shuxian. All in IZCAS.

Description. *Head.* Antennae weakly serrate in male and filiform in female, shaft scattered with short cilia; dorsal side covered with white scales at base. Frons deep reddish, not protruding. Labial palpi reddish brown on dorsal side and yellow on ventral side, third segment slightly extended, about two thirds length of second segment, extending beyond frons. Vertex pale white.

Thorax. Patagia deep greyish brown. Tegulae and thorax greyish brown. Forewing length: male 13–17 mm, female 15–17 mm. Hindwing with rounded apex and outer margin. Wing colour deep yellowish brown; transverse

lines serrate. Forewing with antemedial line brown, serrate and indistinct; discal spot small and black ringed, with white scales on center; medial and postmedial line dentate; medial line brown, wavy and indistinct; postmedial line sometimes forming black spots on veins; terminal line short bar-like between veins, with small protrusion centrally; fringes deep yellowish brown. Hindwing with discal spot larger than that of forewing; postmedial and terminal line same as forewing; fringes same as forewing. Underside. Colour paler reddish brown; discal spots more indistinct than those of upperside; other transverse lines similar to those of upperside.

Male genitalia (Fig. 13). Uncus slender, apical half stick-shaped with two small processes on ventral side, covered with long bristles. Gnathos narrow and even in width. Valva deeply concave at apex; a small triangular process present on inner side of costa; sacculus with a small triangular process near basal part. Saccus small. Aedeagus acute at apex with a small spur subapically.

Female genitalia (Fig. 20). Lamella postvaginalis almost triangular, rounded apically. Lamella antevaginalis broad with strongly serrate margins and a pair of small diverticula centrally. Ostium strongly sclerotized. Ductus bursae narrow and membranous with a strongly sclerotized hood-like structure associated with ostium. Ductus seminalis arising from posterior part of ductus bursae. Corpus bursae large and long oval, posterior part scattered with small spurs; signum narrow and concave on posterior margin, covered with spurs on surface. Sternite 7 with a pair of rounded lateral depressions.

Diagnosis. *O. carnearia*, *O. acutula*, *O. annulifera* and *O. deltaformis* share similar wing patterns. However, *O. deltaformis* differs from the other three species by the smaller and rounder discal spot on the hindwing. In the male genitalia, *O. deltaformis* and *O. annulifera* have a concave apex of the valva. But *O. deltaformis* can be distinguished from *O. annulifera* by the following characters: the costal process of the valva is narrow in *O. deltaformis*, but stout and slightly pointed in *O. annulifera*; the saccular process is small and triangular in *O. deltaformis*, while in *O. annulifera*, it is short digitiform and rounded with spurs terminally. The diagnosis of the female genitalia is under *O. acutula*.

Distribution. China (Hainan, Sichuan).

Etymology. The species name refers to the triangular saccular process.

***Organopoda atrisparsaria* Wehrli, 1924**

Figs 5–7, 14, 21

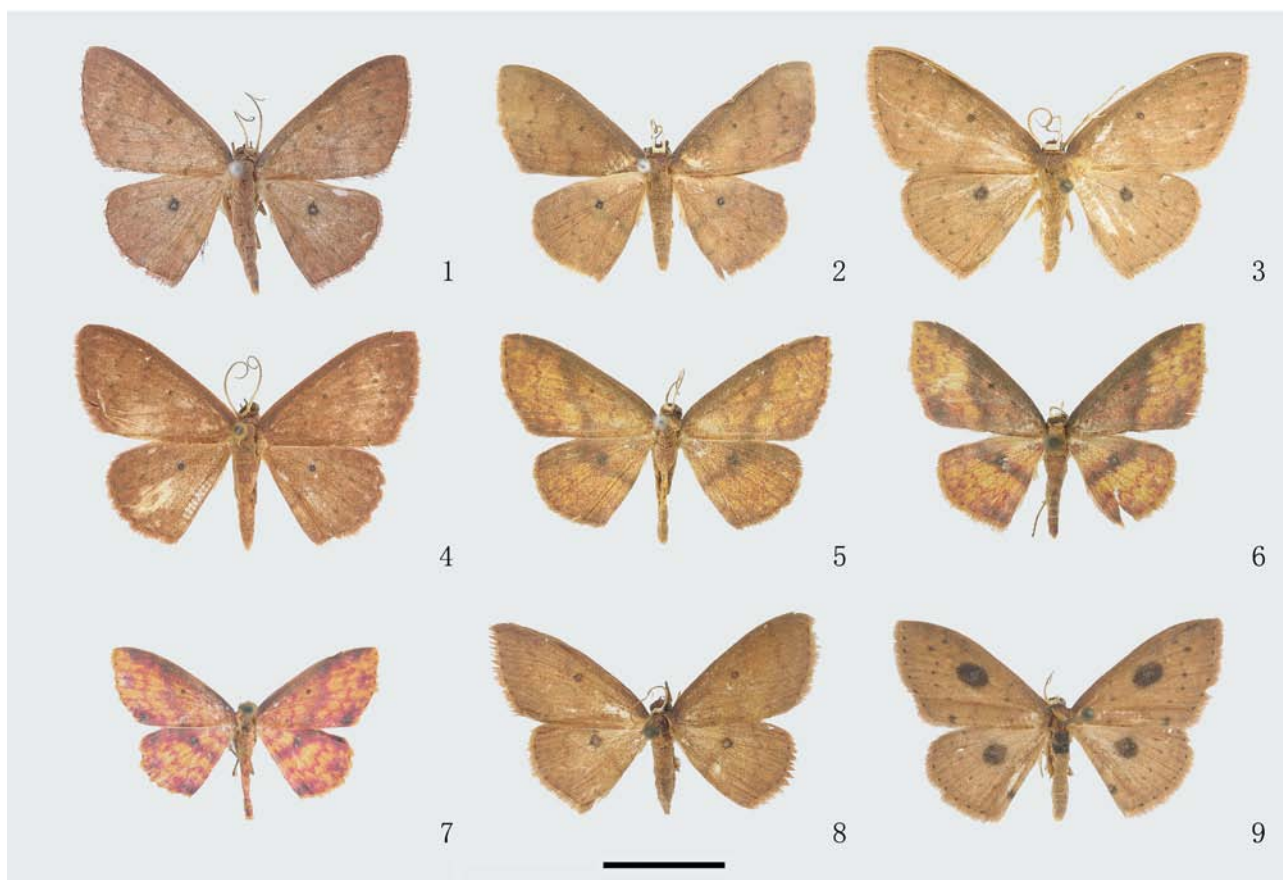
Organopoda atrisparsaria Wehrli, 1924, *Dt. ent. Z. Iris* 37: 62, pl. 1, fig. 10, 21. Syntypes ♂, ♀, China: East China, Shanghai, Kiangsi, Nanking, Mokanschan (Hangtschou) (ZFMK).

Discoglypha atrisparsaria: Prout, 1935, in Seitz, *Macrolepid. World*, 4 (suppl.): 26.

Discoglypha centrofasciaria sensu Xue, 1992, in Liu, *Icon. Forest Insects Hunan China*: 827, fig. 2673. (Misidentification)

Material examined. CHINA: Henan: 1♀, Neixiang, Baotianman natural reserve, 623 m, 12.VIII.2008, coll. Xue Dayong; 1♂, Xinyang, Jigong Shan, 250 m, 20–21.VII.2002, coll. Han Hongxiang. **Shaanxi:** 1♂1♀, Zhouzhi, Houzhenzi, 1350 m, 24.VI.1999, coll. Zhu Chaodong; 1♂, Foping, Longcaoping, 1256 m, 3.VII.2008, coll. Cui Junzhi; 2♂, Ningshan, Huoditang, 1538–1600 m, 5.VII.1999, 11–15.VII.2012, coll. Yang Xiushuai & Yuan Decheng. **Gansu:** 1♀, Wenxian, Fanba, 800 m, 26.VI.1998, coll. Zhang Xuezhong. **Zhejiang:** 2♂, Lin'an, West Tianmu Shan, 1500 m, 28–29.VII.2003, coll. Han Hongxiang & Xue Dayong (slide no. 3476); 1♀, West Tianmu Shan, Xianrending, 1506 m, 27.VII.2011, coll. Cheng Rui & Yan Keji; 1♀, West Tianmu Shan, 24.VI.1957, coll. Su Jiyao; 1♂1♀, Pan'an, Huangtan linchang, 891 m, 27–28.VII.2015, coll. Cheng Rui & Ban Xiaoshuang; 33♂25♀, Yuyao, Siming Shan, 814 m, 22–25.VII.2015, 2.VIII–31.VII.2016, coll. Li Xinxin *et al.*; 2♀, Jingning, Wangdongyang gaoshan wetland, 1010 m, 7–8.VIII.2016, coll. Li Xinxin. **Hubei:** 2♂1♀, Xingshan, Longmenhe, 1300 m, 6–7.V.1994, coll. Li Wenzhu; 3♂6♀, Yingshan, Wujiashan, 860 m, 28–30.VI.2014, coll. Cui Le & Jiang Nan (slide no. 3378); 1♂1♀, Yingshan, Taohuachong, 590 m, 23–27.VI.2014, coll. Jiang Nan *et al.*; 1♀, Shennongjia, Honghua, 860 m, 17–21.VIII.1981, coll. Han Yinheng; 1♀, Badong, Sanxia linchang, 180 m, 13.V.1994, coll. Li Wenzhu. **Jiangxi:** 15♂9♀, Guling, VII–VIII.1935, IX.1939, coll. O. Piel; 1♀, Jinggang Shan, Huangyangjie, 1090 m, 4.VIII.2013, coll. Yang Chao; 1♂, Lu Shan zhiwuyuan, 9.VI.1990; 1♀, Shangrao, Jinsha, Sanqing Shan, 380–390 m, 20.IV.2007, coll. Bai Haiyan & Du Xicui (presented by Nankai University). **Hunan:** 1♂, Sangzhi, Badagong Shan, Xiaozhuangping, 14.VI.2015, coll. Yao Jian & Zhao Kaidong; 1♀, Nanyue, Tiefosi, VI.1980; 1♂, Heng Shan, Nantaisi, 20.VIII.1980; 3♀, Heng Shan, 21–24.VIII.1979, 3.IX.1979, coll. Zhang Baolin. **Fujian:** 2♂1♀, San'gang,

20.VIII.1979, 29.VI.1982, coll. Jiang Fan *et al.*; 1♂, Wuyi Shan, Dazhulan, 1150 m, 28.VII.2006, coll. Xie Juan & Xue Dayong. **Guangxi**: 3♂4♀, Maoer Shan, Jiuniutang, 1146 m, 16.VIII.2012, coll. Cheng Rui & Yang Chao; 1♂1♀, Maoer Shan, Gaozhai, 448 m, 13–15.VIII.2012, coll. Yang Chao; 1♂2♀, Maoer Shan, Antangping, 1579 m, 17–18.VIII.2012, coll. Yang Chao *et al.*; 1♂, Longsheng, Hongtan, 900 m, 11.VI.1963, coll. Wang Chunguang. **Sichuan**: 17♂3♀, Emei Shan, Qingyin'ge, 800–1000 m, IV–VII.1957, coll. Zhu Fuxing *et al.*; 1♂1♀, Qingcheng Shan, 1000 m, 29.V.1979, 4.VI.1979, coll. Gao Ping & Shang Jinwen; 3♂, Wanxian, Wang'erbao, 1200 m, 9, 11.VII.1993, 27.V.1994, coll. Yao Jian & Li Wenzhu; 2♂1♀, Luding, Moxi, Baiyang, 1691 m, 1.VIII.2014, coll. Li Xinxin & Pan Xiaodan; 1♂, Mianzhu, Jiulong Shan, Shizipo, 810 m, 29–31.VII.2016, coll. Cui Le & Li Henan; 2♂, Hongya, Wawu Shan, Jinhuaqiao, 1147 m, 12–14.VIII.2016, coll. Cui Le & Li Henan; 3♀, Baoxing, Fengtongzhai, 1590 m, 1–5.VIII.2016, coll. Cui Le & Li Henan; 1♀, Luding, Moxi, 1949 m, 4.VIII.2013, coll. Cheng Rui. **Chongqing**: 1♀, Xishui, Pinghe, 1200 m, 1.VI.2000, coll. Du Yanli (presented by Nankai University); 1♂, Fanjing Shan, Huguosi, 1300 m, 1.VIII.2001, coll. Li Houhun & Wang Xinpu (presented by Nankai University). **Yunnan**: 1♂, Xiaocaoba linchang, 27.VI.1982 (slide no. 3443); 1♀, Gongshan, Puladi, 1298 m, 6–7.VII.2014, coll. Li Xinxin & Pan Xiaodan. All in IZCAS.



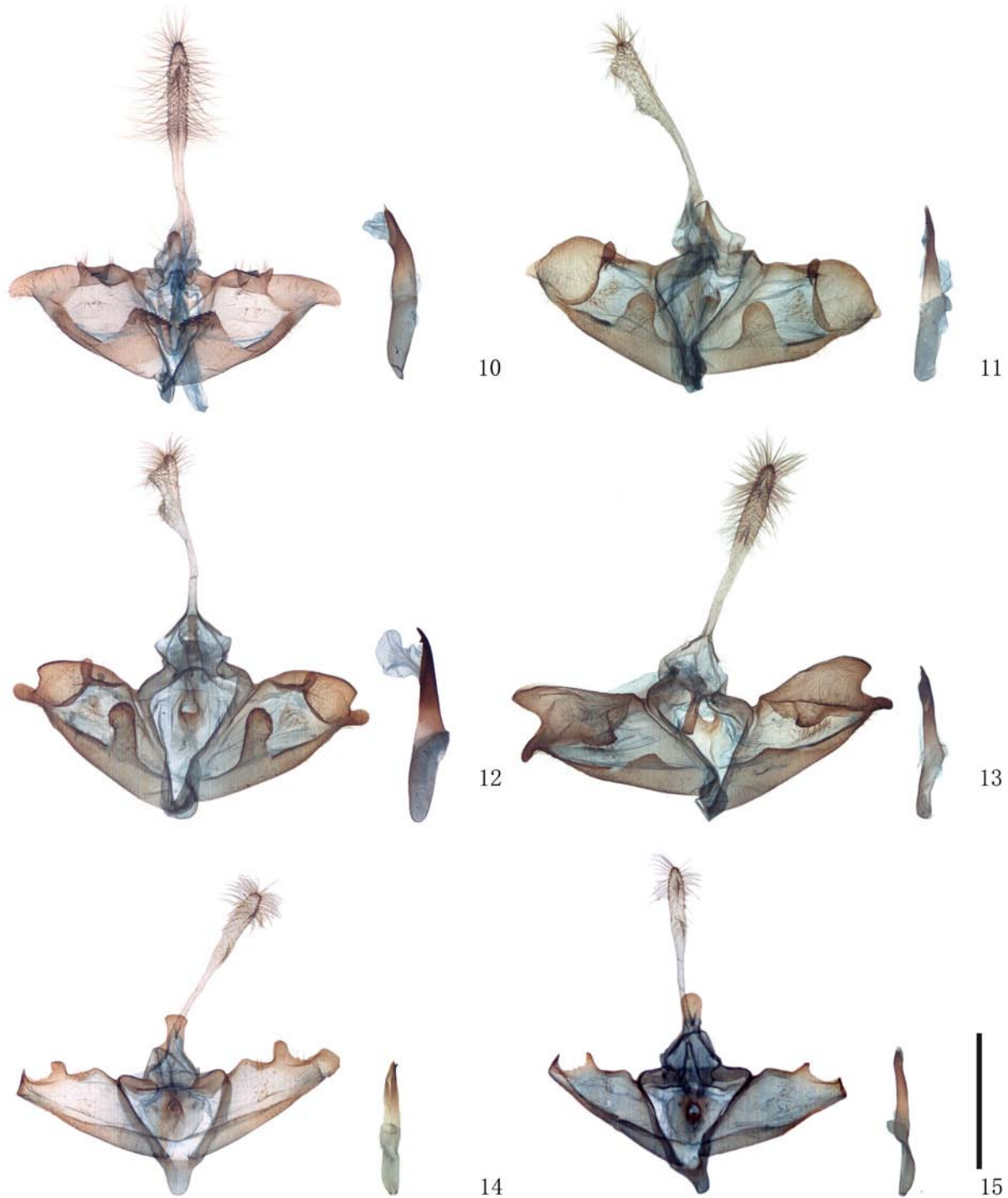
FIGURES 1–9. Male Adults of *Organopoda*. 1. *O. carnearia* (Walker, 1861), Tibet; 2. *O. acutula* **sp. nov.**, holotype, Gansu; 3. *O. annulifera* (Butler, 1889), Sichuan; 4. *O. deltaformis* **sp. nov.**, holotype, Hainan; 5–7. *O. atrisparsaria* Wehrli, 1924. 5. Sichuan; 6. Zhejiang; 7. Chongqing; 8. *O. brevivalpis* Prout, 1926, Sichuan; 9. *O. megiste* **sp. nov.**, holotype, Sichuan. Scale bar=1 cm.

Diagnosis. The species is similar to *O. brevivalpis* in the short labial palpi. However, *O. atrisparsaria* differs from *O. brevivalpis* in the following characters: the medial lines of both wings are deeper and broader than in *O. brevivalpis*; the discal spot on the forewing is smaller than in *O. brevivalpis*. In the genitalia, *O. atrisparsaria* and *O. brevivalpis* differ from other congeners by the following characters: in the male genitalia, the apex of the valva is narrow and curved inwards; the costa of the valva has a short process; the saccular processes are absent; in the female genitalia, the lamella antevaginalis is not well developed; the signum is small; sternite 7 is weakly sclerotized on the posterior margin. The genitalia of *O. atrisparsaria* differ from *O. brevivalpis* in the following characters: the costal process of the valva of the male genitalia is much larger with a more rounded apex in *O. atrisparsaria*, while

it is much smaller with a pointed apex in *O. brevipalpis*; the lamella postvaginalis of the female genitalia is protrudes on the posterior margin, while it is flat in *O. brevipalpis*.

Distribution. China (Henan, Shaanxi, Gansu, Jiangsu, Shanghai, Zhejiang, Hubei, Jiangxi, Hunan, Fujian, Guangxi, Sichuan, Chongqing, Yunnan).

Remarks. The holotype was examined. We found some intraspecific variations in *O. atrisparsaria*: the colour of the wings varies from yellow (fig. 7) to yellowish brown (figs 5, 6); the colour of the transverse lines is usually yellowish brown (figs 5, 6), and sometimes pinkish red (fig. 7). These variations all occur sympatrically in Zhejiang, China (figs 6, 7).



FIGURES 10–15. Male genitalia of *Organopoda*. 10. *O. carnearia* (Walker, 1861); 11. *O. acutula* **sp. nov.**, paratype; 12. *O. annulifera* (Butler, 1889); 13. *O. deltaformis* **sp. nov.**, holotype; 14. *O. atrisparsaria* Wehrli, 1924; 15. *O. brevipalpis* Prout, 1926. Scale bar = 1 mm.

Discoglypha centrofasciaria (Leech, 1897) in Xue (1992) was a misidentification of *O. atrisparsaria*. The wing patterns of *D. centrofasciaria* (Leech, 1897) (Prout 1912–1916: pl. 5: f) are very similar to the paler form of *O. atrisparsaria*; the only difference is that the discal spot of the hindwing is situated outside the medial line in *D. centrofasciaria*, but it passes across the discal spot in *O. atrisparsaria*. Prout (1934–1939) also suggested that *D. centrofasciaria* might be related to *O. atrisparsaria*. Thus, we suspect that *D. centrofasciaria* is potentially a senior synonym of *O. atrisparsaria*. Further morphological study is needed to confirm the systematic position of *D. centrofasciaria*.

Organopoda brevivalpis Prout, 1926

Figs 8, 15, 22

Organopoda brevivalpis Prout, 1926, *J. Bombay nat. Hist. Soc.*, 31 (1): 136, pl. 1, fig. 7. Holotype ♂, Burma (upper): Htawgaw (NHMUK).

Material examined. CHINA: **Guangxi:** 3♂, Napo, Defu, 1350–1440 m, 3–4.IV.1998, 18.VI.2000, coll. Li Wenzhu *et al.* **Sichuan:** 21♂1♀, Emei Shan, Qingyin'ge, 800–1000 m, 23–30.IV.1957, V–VII.1957, coll. Huang Keren *et al.* (slide no. 3446); 6♂1♀, Luding, Moxi, 1600 m, 17–18.VI.1983, 19–20.V.2009, coll. Li Jing & Chai Huaicheng; 3♂, Luding, Xinxing, 1800–1900 m, 13–14.VI.1983, coll. Wang Shuyong & Chai Huaicheng; 1♂, Luding, Moxi, Hailuogou, Yihaoyingdi, 3155 m, 15.V.2009, coll. Li Jing; 1♂, Barkam, 2600 m, 21.VIII.1983, coll. Chai Huaicheng. **Yunnan:** 3♂4♀, Tengchong, Dahaoping, 2020 m, 24–26.V.1992, 5–7.VIII.2007, coll. Wu Chunguang & Xue Dayong (slide no. 3449); 1♂, Yongsheng, Liude, 2250 m, 10.VII.1984, coll. Liu Dajun. All in IZCAS.

Diagnosis. See *O. atrisparsaria*.

Distribution. China (Guangxi, Sichuan, Yunnan), Burma.



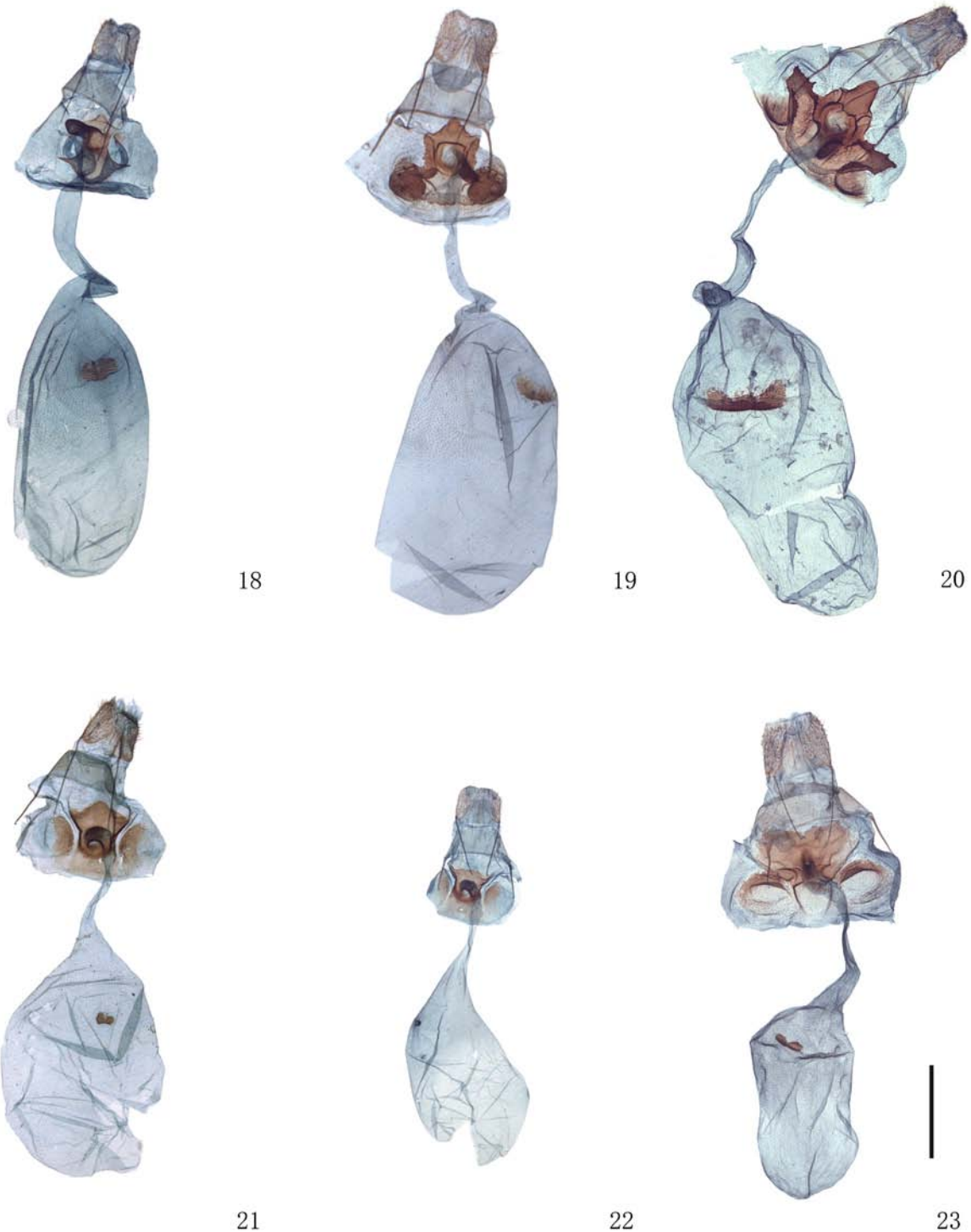
FIGURES 16–17. **FIGURE 16.** Male genitalia of *O. megiste* sp. nov., paratype. Scale bar = 1 mm. **FIGURE 17.** Male hind leg of *O. atrisparsaria* Wehrli, 1924. Scale bar = 1 mm.

Organopoda megiste sp. nov.

Figs 9, 16, 23

Type material. Holotype, ♂, CHINA: **Sichuan:** Emei Shan, Qingyin'ge, 800–1000 m, 20.IV.1957, coll. Zhu Fuxing (slide no. 3455). Paratypes: **Jiangxi:** 1♀, Jiulian Shan, 9.VI.1975, coll. Zhang Baolin. **Guangdong:** 1♀, Shixing, Chebaling, 330 m, 1–2.VIII.2013, coll. Yang Chao (slide no. 3458). **Guangxi:** 2♂, Jinxiu, Shengtang Shan, 900–1900 m, 28–29.VI.2000, coll. Li Wenzhu; 1♀, Jinxiu, Linhai Shanzhuang, 1000 m, 2.VII.2000, coll. Li Wenzhu; 2♂, Jinxiu, Luoxiang, 200–450 m, 15.V.1999, 30.VI.2000, coll. Han Hongxiang & Li Wenzhu; 1♀, Jinxiu, Huawang Shanzhuang, 550 m, 13.IV.2002, coll. Hao Shulian & Xue Huaijun (slide no. 4573). **Sichuan:** 10♂1♀, same as holotype, 16–29.IV.1957, 29.VI.1957, coll. Zhu Fuxing *et al.* All in IZCAS.

Description. *Head.* Antennae weakly serrate in male and filiform in female, shaft scattered with short cilia; dorsal side covered with white scales at base. Frons deep reddish, not protruding. Labial palpi reddish brown on dorsal side and pale yellow on ventral, third segment slightly extended, about two thirds length of second segment, extending beyond frons. Vertex pale white.



FIGURES 18–23. Female genitalia of *Organopoda*. 18. *O. carnearia* (Walker, 1861); 19. *O. acutula* **sp. nov.**, paratype; 20. *O. deltaformis* **sp. nov.**, paratype; 21. *O. atrisparsaria* Wehrli, 1924; 22. *O. brevipalpis* Prout, 1926; 23. *O. megiste* **sp. nov.**, paratype. Scale bar = 1 mm.

Thorax. Patagia deep greyish brown. Tegulae and thorax greyish brown. Forewing length: male 12–17 mm, female 13–15 mm. Forewing with costa slightly protruding outwards. Wing colour deep yellowish brown. Forewing

with antemedial line black, composed of three black spots; discal spot black, broad, and ringed with white scales centrally, very large and almost rounded; medial line brown, and indistinct; postmedial line forming black spots on veins, weakly connected, the spot near terminal margin largest; terminal line composed of black spots between veins; fringes deep yellowish brown. Hindwing with discal spot slightly smaller than that of forewing and other transverse lines similar to those of forewing. Underside. Colour paler reddish brown; discal spots of both wings more distinct than those of upperside, others similar to those of upperside.

Male genitalia (Fig. 16). Uncus with apical half dilated with two processes on ventral side and covered with long bristles. Gnathos sheet-like and rolling inwards. Valva broad, with a narrow and almost rounded apex; costa without process; a small ridge weakly raised near basal part, close to costal margin and covered with long bristles; sacculus with an arched process at base, covered with short bristles on terminal margin. Saccus small. Aedeagus narrow and acute at apex with a small spur subapically.

Female genitalia (Fig. 23). Lamella postvaginalis broad and heart-shaped. Lamella antevaginalis with a pair of small oval depressions on sides. Ostium small and sclerotized. Ductus bursae narrow and membranous, with a strongly sclerotized hood-like structure associated with ostium. Corpus bursae large, long and elliptical; signum oval, concave on posterior margin, covered with spurs on surface. Sternite 7 sclerotized with three scabrous oval protrusions.

Diagnosis. The species is characterized by the large, black discal spots on both wings; the postmedial line of each wing forms a large black spot near the anal margin. In the male genitalia, the gnathos is sheet-like and rolling inwards; the costa of the valva has no process; the aedeagus is narrow. In the female genitalia, the lamella postvaginalis is large and heart-shaped; three protrusions are present on the female sternite 7.

Distribution. China (Jiangxi, Guangdong, Guangxi, Sichuan).

Etymology. The species is named on the basis of the Greek word “*megistos*”, which refers to the large discal spots on both two wings.

Acknowledgements

We sincerely thank Dr Marianne Espeland (ZFMK) for allowing examination of material under her curation and Dr Dieter Stüning (ZFMK) for his great help with our work. We express our sincere thanks to Sir Anthony Galsworthy (Scientific Associate, the Natural History Museum, London, UK) for his valuable linguistic corrections. We are grateful to all collectors whose contributions made our work possible. We also appreciate the work of Ms. Yang Chao (IZCAS) in preparing some specimens and dissections. This project was supported by the National Natural Science Foundation of China (grant No. 31672331, 31872966, 31872967), the Ministry of Science and Technology of China (No. 2015FY210300), a grant from the Key Laboratory of Zoological Systematics and Evolution (Chinese Academy of Sciences, grant No.Y229YX5105), and the National special fund on basic research of Science and Technology (2014FY110100).

References

- Bastelberger, S.R. (1909–1910) Neue Geometriden aus Central-Formosa. *Entomologische Zeitschrift*, 23, 1–241.
<https://doi.org/10.1002/mmnd.48019090121>
- Butler, A.G. (1889) *Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum*. London, Part 7, i–iv + 124 pp., pls 121–138.
- Comstock, J.H. (1918) *The Wings of Insects*. Comstock Publishing Company, Ithaca, New York, 430 pp.
- Choi, S.W. (2009) *Organopoda carnearia* (Walker) (Lepidoptera: Geometridae), New to Korea. *Korean Journal Systematic Zoology*, Vol. 25 (3), 283–285.
<https://doi.org/10.5635/KJSZ.2009.25.3.283>
- Cui, L., Jiang, N., Stüning, D. & Han, H.X. (2018a) A review of *Synegiodes* Swinhoe, 1892 (Lepidoptera: Geometridae), with description of two new species. *Zootaxa*, 4387 (2), 259–274.
<https://doi.org/10.11646/zootaxa.4387.2.2>
- Cui, L., Xue D.Y. & Jiang, N. (2018b) *Aquilargilla* gen. nov., a new genus of Sterrhinae from China with description of two new species (Lepidoptera, Geometridae). *Zootaxa*, 4514 (3), 431–437.
<https://doi.org/10.11646/zootaxa.4514.3.8>
- Cui, L., Xue, D.Y. & Jiang, N. (2019a) Description of two new species of *Rhodostrophia* Hübner, 1823 from China (Lepidopte-

- ra, Geometridae). *Zootaxa*, 4563 (2), 337–353.
<https://doi.org/10.11646/zootaxa.4563.2.7>
- Cui, L., Xue, D.Y. & Jiang, N. (2019b) A review of *Timandra* Duponchel, 1829 (Lepidoptera, Geometridae) from China, with description of seven new species. *Zookeys*, 829, 43–74.
<https://doi.org/10.3897/zookeys.829.29708>
- Guenée, A. (1858) Uranides et Phalénites 1. In: Boisduval, J.B.A.D. & Guenée, A. (Eds.), *Histoire naturelle des Insectes* (Species général des Lépidoptères), 10, pp. 1–584., Atlas, pls. 1–22.
- Hampson, G.F. (1893) The Macrolepidoptera Heterocera of Ceylon. *Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum*, 9, v+182., pls. 157–176.
- Hausmann, A. (2001) Introduction. Archiearinae, Orthostixinae, Desmobathrinae, Alsophilinae, Geometrinae. In: Hausmann, A. (Ed.), *The Geometrid Moths of Europe*, Vol. 1. Apollo Books, Stenstrup, pp. 1–282.
https://doi.org/10.1007/978-1-4757-3423-2_1
- Han, H.X. & Xue, D.Y. (2002) Lepidoptera: Geometridae. In: Huang, F.S. (Ed.), *Insects of Hainan Island*. Science Press, Beijing, pp. 543–561.
- Holloway, J.D. (1997) The Moths of Borneo: Family Geometridae, Subfamily Sterrhinae. *Malayan Nature Journal*, 10, 1–242.
- Klots, A.B. (1970) Lepidoptera. In: Tuxen, S.L. (Ed.), *Taxonomist's Glossary of Genitalia in Insects*. Munksgaard, Copenhagen, pp. 115–130.
- Leech, J.H. (1897) On Lepidoptera Heterocera from China, Japan, and Corea. *Annals and Magazine of Natural History*, (6) 20, 65–111, 228–248.
<https://doi.org/10.1080/00222939708680620>
- Nichols, S.W. (1989) *The Torre-Bueno Glossary of Entomology*. New York Entomological Society in cooperation with the American Museum of Natural History, New York, xvii + 840 pp.
- Parsons, M.S., Scoble, M.J., Honey, M.R., Pitkin, L.M. & Pitkin, B.R. (1999) The catalogue. In: Scoble, M.J. (Ed.), *Geometrid moths of the world: a Catalogue (Lepidoptera, Geometridae)*. CSIRO, Collingwood, pp. 1–1016.
- Pierce, N. (1914) *The Genitalia of the Group Geometridae of the British Islands*. E.W. Classey Ltd., Middlesex, xxix + 88 pp., 48 pls. [reprint 1976]
- Prout, L.B. (1926) On a collection of moths of the family Geometridae from Upper Burma made by Captain A.E. Swann. Part 1. *Journal of the Bombay Natural History Society*, 31, 129–146.
<https://doi.org/10.5962/bhl.title.124035>
- Prout, L.B. (1920–1941) The Indoaustralian Geometridae. In: Seitz, A. (Ed.), *Macrolepid. World*, 12. Verlag A. Kernen, Stuttgart, pp. 1–356., pls. 1–41, 50.
- Prout, L.B. (1934–1939) Die Spanner des Palaearktischen Faunengebietes. In: Seitz, A. (Ed.), *Die Gross-Schmetterlinge der Erde*. Bd. 4 (Suppl.). Verlag A. Kernen, Stuttgart, pp. 1–253., pls. 1–18.
- Prout, L.B. (1934) Geometridae: Subfamilia Sterrhinae I, II. In: Strand, E. (Ed.), *Lepidopterorum Catalogus*, 61 (1), 1–176.
- Schrank, A. (1802) Fauna Boica: durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere. *Fauna Boica*, 2 (2), 1–412.
- Scoble, M.J. (1992) *The Lepidoptera, Form, Function and Diversity*. Oxford University Press, Oxford, xi + 404 pp.
- Scoble, M.J. & Hausmann, A. (2007) Online list of valid and available names of the Geometridae of the World. Lepidoptera Barcode of Life, iBOL. http://www.lepbarcoding.org/geometridae/species_checklists.php?region=1&action=page_search (accessed 20 May 2019)
- Swinhoe, C. (1892) New species of Heterocera from Khasia Hills. Part II. *Transactions of the Entomological Society of London*, 1892 (1), 1–487.
<https://doi.org/10.1111/j.1365-2311.1892.tb03043.x>
- Walker, F. (1861) *List of the specimens of lepidopterous insects in the collection of the British Museum*, part 22. British Museum, London, 500–755 pp.
- Warren, W. (1896) New Geometridae in the Tring Museum. *Novitates Zoologicae*, 3, 99–148.
<https://doi.org/10.5962/bhl.part.5422>
- Wehrli, E. (1924) Neue palaarktische Geometriden-Arten und Formen aus Ostchina. (Sammlung Höne.). *Deutsche Entomologische Zeitschrift, Iris*, 37, 61–75., pl. 1.
- Xue, D.Y. (1992) Geometridae. In: Liu, Y.Q. (Ed.), *Iconography of Forest Insects in Hunan China*. Hunan Science & Technology Press, Hunan, pp. 807–904.
- Xue, D.Y., Cui, L. & Jiang, N. (2018) A review of *Problepsis* Lederer, 1853 (Lepidoptera: Geometridae) from China, with description of two new species. *Zootaxa*, 4392 (1), 101–127.
<https://doi.org/10.11646/zootaxa.4392.1.5>