

[研究文章 Research Article]

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## Notes on Uncommon and Newly Recorded Geometrid Moths of Taiwan (Lepidoptera: Geometridae). Part 1

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**Abstract.** This study represents the first in a series of papers which aim to elucidate the taxonomic and distributional issues of uncommon and unrecorded geometrid moths of Taiwan. Nine species are included, with six newly recorded: *Eucyclodes infracta* (Wileman, 1911); *Megabiston plumosaria* (Leech, 1891); *Hypomecis hyposticta* (Wehrli, 1925); *Eilicrinia nuptaria* Bremer, 1864; *Apochima excavata* (Dyar, 1905) and *Planociampa chlora* Yazaki & Wang, 2003. The recommended or newly proposed Chinese common names are also given, with comments, for four geometrid species that occur in Taiwan, i.e. *H. hyposticta*, *Xyloscia dentifera* Inoue, 1986, *E. nuptaria*, *A. praeacutaria* (Inoue, 1976).

**Key words:** Fauna, species richness, continental island, Oriental region, Indo-Australian region

### Introduction

The geometrid moths represent the largest family of Lepidoptera and the most commonly used group for assessing regional Lepidoptera species numbers, e.g. Scoble *et al.* (1995), Choi, (2006), Paknia and Rajael (2015), for understanding the diversity and faunal composition along environmental gradients, e.g. Brehm and Fiedler (2003), Axmacher *et al.* (2004), and for sampling in large-scale evolutionary and ecological studies, e.g. Axmacher and Fiedler (2008), Chen *et al.* (2009), Välimäki *et al.* (2013), Heidrich *et al.* (2018), Xing *et al.* (2018), Wu *et al.* (2019). The most recent records indicate that there are 327 genera and 872 species found in Taiwan (TaiCOL, 2020), representing about one-fifth of the Taiwanese moth fauna. The present study, representing the first in series, aims to further document the species richness and distribution patterns of relatively uncommon geometrid species of Taiwan for ecological and conservation purposes. We also propose new Chinese common names for some Taiwanese geometrid species based on the updated information of their systematic position, where necessary.

### Materials and methods

The specimens were examined or borrowed from the following institutions:

CCMF – Collection of Chien-Ming Fu, Taichung.

CHRT – Collection of Han-Rong Tzuoo, Nantou.

CRS – Collection of Rikio Sato, Niigata.

NTM – National Taiwan Museum, Taipei.

NMNS – National Museum of Natural Science, Taichung.

HNHM – Hungarian Natural History Museum, Budapest.

TFRI – Insect collection of Taiwan Forestry Research Institute, Taipei.

Genitalia preparations for morphological studies

Genitalia were prepared following the general method described by Betts (1987) with slight modifications. After maceration of the abdomen in 10% KOH and subsequent cleaning, male genitalia were carefully removed from the abdomen, and abdominal segments 1–8 were opened along the caudocephalic axis from the right side. Female genitalia were removed entirely from the abdomen,

cleaned and mounted ventral side uppermost. All of the membranous genital tubes and bursae derived from the genital openings were preserved. Genitalia and abdominal skins of both sexes were stained with pen ink (Pilot brand), preserved in 70% ethanol, and then transferred to 99.5% ethanol before being slide mounted in Euparal. Specimens were photographed using a Nikon D600 digital camera and slides were photographed using a Nikon D500 digital camera with flash.

Chinese species common names

The newly proposed Chinese common names for selected geometrid species, with comments, are marked with an asterisk.

## Results

### *Timandromorpha enervata* Inoue, 1944

小缺口鏢翅青尺蛾

(Fig. 1a)

*Timandromorpha enervata* Inoue, 1944, *Trans. Kansai ent. Soc.* 14 (1): 63, text-figs 4, 5; Chang, 1990a: 59, fig.; Inoue, 1992: 120; Fu *et al.*, 1995: 29; Wang, 1997: 55, figs; Kim *et al.*, 2001: 20, fig. 8, pl. 1: 7.

*Timandromorpha discolor*: Shin, 1983: 176, pl. 2, *nec* Warren, 1896.

*Timandromorpha discolor enervata*: Inoue, 1961: 37; Inoue, 1982, 1: 430, 2: pl. 57.

**Specimens examined. TAIWAN:** 1♂, Hsinchu Co., Yulao, 1,400 m, 7. V. 2016, leg. S. Wu & J. C. Huang (TFRI); 1♀, Taichung Co., Baxianshan, 1,000 m, 18. IX. 1993, leg. C. M. Fu (CCMF).

**Distribution.** Japan, Taiwan, North India and North Borneo (Kim *et al.*, 2001).

**Bionomics.** This species is restricted to the mid-elevation broadleaf forests of Northern and Central Taiwan. Based on current records, the adults can be found in May and September.

**Note.** The species is common in South East Asia but is rare in Taiwan.

### *Eucyclodes infracta* (Wileman, 1911)

彎彩翠尺蛾

(Figs 1b, 2a, 2g)

*Thalassodes infracta* Wileman, 1911, *Trans. ent. Soc. Lond.*, 1911: 342, pl. 30, fig. 16.

*Chloromachia infracta*: Prout, 1912, in Wystman, *Genera Insectorum*, 129: 251.

*Eucyclodes infracta*: Holloway, 1996: 23, 235; Han & Xue, 2011: 526, figs 366, 685, 880, pl. 19: 15; Nakajima, 2011: 209, pl. 43:1, 2.

**Specimens examined. TAIWAN:** New Taipei City: 1♀, Wanli, Gueiho, 12. X. 2014, leg. J. J. Cherng (TFRI); 2♂♂, Shuangxi, Taiping, 12. VIII. 2015, A. P. Cheng (TFRI).

**Distribution.** Japan, China (Han & Xue, 2011); Taiwan (new record).

**Bionomics.** Two specimens were collected in Northern Taiwan. Based on current records, the adults can be found in August and October.

**Note.** The type locality of this species is Honshu, Japan. There are no remarkable differences between the genitalia (in both sexes) of Chinese and Taiwanese specimens (Han & Xue, 2011). The Chinese common name follows Han & Xue (2011).

### *Megabiston plumosaria* (Leech, 1891)

羽霾尺蛾

(Figs 1c, 2b)

*Biston plumosaria* Leech, 1891, *Entomologist* 24 (suppl.): 43.

*Megabiston plumosaria*: Inoue, 1982: 555, pl. 99: 18, 19; Kim *et al.*, 2001: 139, fig. 159, pl. 14: 21, 22; Sato & Kawakami, 2001: 262, figs 15, 17-19; Sato & Fan, 2011: 121, pl. 20: 1.

*Boarmia theae* Matsumura, 1917, *Oyo-Konchu-Gaku* 1: 603, pl. 27, fig. 5.

**Specimens examined. TAIWAN:** 1♂, Taoyuan Co., Shihleng, 29. XII. 1988, leg. H. Y. Wang (NTM); 1♂ Ilan/Taoyuan Prov., Fuhsing district, Xicun, 1,106 m, 24°38'33"N, 12°26'42"E, 9. II. 2018, leg. Balázs Benedek (HNHM); 1♂, same collecting locality, 12–13. II. 2018 (HNHM); 1♂, same collecting locality, 19. II. 2018 (HNHM); 1♂, Ilan Co., Fushan, 17. I. 1990, leg. Y. B. Fan, slide TFRI 71713 (TFRI).

**Distribution.** Japan, Korea, China, Russia (Kim *et al.*, 2001; Sato & Fan, 2011); Taiwan (new record).

**Bionomics.** This species occurs in low to mid-elevation broadleaf forests in Northern Taiwan. Based on current records, the adults occur during December and next February.

**Note.** The type locality of this species is Honshu, Japan. There are no remarkable differences between the genitalia (in both sexes) of Chinese and Taiwanese specimens (Han & Xue, 2011). The Chinese common name follows Sato & Fan (2011).

***Hypomecis hyposticta* (Wehrli, 1925)**

墨褐尺蛾\*、超小土尺蛾

(Figs 1d, 1e, 2c, 2h)

*Boarmia hyposticta* Wehrli, 1925, *Mitt. münch. ent. Ges.* 15 (1–5): 58, pl. 1: 21.

*Hypomecis hyposticta*: Parsons *et al.*, 1999: 474; Sato & Fan, 2011: 64, pl. 8: 12.

**Specimens examined. TAIWAN:** 3♂♂, Pintung Co., Shouka, 450 m, 8. IX. 2011, leg. Y. C. Lin (TFRI); 6♂♂1♀, same collecting locality, 27. X. 2011, leg. Y. C. Lin, slide TFRI157135♀ (TFRI); 2♂♂, same collecting locality, 24. XI. 2011, leg. Y. C. Lin, slide TFRI142182♂ (TFRI); 1♂, same collecting locality, 20. XII. 2011, leg. Y. C. Lin (TFRI); 3♂♂, same collecting locality, 22. XII. 2011, leg. Y. C. Lin (TFRI); 5♂♂, same collecting locality, 1. II. 2012, leg. Y. C. Lin (TFRI); 6♂♂, same collecting locality, 22. III. 2012, leg. Y. C. Lin (TFRI); 2♂♂, same collecting locality, 24. V. 2012, leg. Y. C. Lin (TFRI); 2♂♂, same collecting locality, 19. VI. 2012, leg. Y. C. Lin (TFRI); 1♂, same collecting locality, 15. VIII. 2012, leg. Y. C. Lin (TFRI); 3♂♂, same collecting locality, 13. IX. 2012, leg. Y. C. Lin (TFRI); 1♂, same collecting locality, 16. X. 2012, leg. Y. C. Lin (TFRI); 6♂♂, same collecting locality, 13. XII. 2012, leg. Y. C. Lin (TFRI).

**Distribution.** China (Sato & Fan, 2011); Taiwan (new record).

**Bionomics.** In Taiwan, this species has only been collected from Shouka in the southeastern region. The adults have been collected in almost every month of the year, with the exception of January and July, based on monthly survey during 2011–2012.

**Note.** The type locality of this species is Southern China. Based on information kindly provided to us by Dr. Rikio Sato (Niigata), the male genitalia of Taiwanese specimens are known to conform with those collected in the Nanling Mountains (genitalia slide: RS-6363 in CRS). The Chinese common name “超小土尺蛾” has been given in Sato & Fan (2011); herein we propose a new common name to unify the generic common name used in Taiwan.

***Xyloscia dentifera* Inoue, 1986**

銳齒木尺蛾\*、銳齒枝尺蛾、缺角尺蛾

(Fig. 1f)

*Xyloscia dentifera* Inoue, 1986, *Bull. Fac. domest. Sci. Otsuma Wom. Univ.* 22: 254, figs 52, 53; Chang & Fan, 1989: 19; Chang, 1990b: 136, fig.; Fu *et al.*, 1995: 26, pl. 1: 13; Wang, 1998: 357, fig.; Parsons *et al.*, 1999: 978.

**Specimens examined. TAIWAN:** 1♂, Hsinchu Co., Yulao, 1,500 m, 27. IV. 2014, leg. C. G. Lai (TFRI); 1♂, same collecting locality, 21. V. 2015, leg. C. G. Lai (TFRI); Taichung Co., 1♂, Daxueshan Forest Road 22 km, 1,500 m, 14. IV. 2007, leg. C. M. Fu (CCMF); 1♂, Taichung Co., Baxianshan, 1,000 m, 1. X. 1994, leg. C. M. Fu (CCMF); 1♀, same collecting locality, 5. XI. 1994, leg. C. M. Fu (CCMF); Nantou Co., Dongpu, 19. IV. 1985, leg. B. S. Chang (NMNS); 1♂, same collecting locality, 23. II. 1991, leg. H. R. Tzuoo (CHRT); 1♂, Nantou, Meifeng, 27–28. VIII. 1991, leg. C. S. Lin (NMNS); 2♂♂, Kaohsiung City, Liguan, 1,800 m, 19. IV. 2017, leg. Fu & Cheng (CCMF).

**Distribution.** Taiwan (Inoue, 1986).

**Bionomics.** This species is distributed in mid-elevation broadleaf forests. The adults have been collected from February–May, in August, and from October–November.

**Note.** We follow the generic common name, 木尺蛾, in National Science Data Infrastructure of Forestry (2020) and propose a recommended specific common name.

***Eilicrinia nuptaria* Bremer, 1864**

尖耳蠨尺蛾

(Figs 1g, 1h, 2d, 2i)

*Eilicrinia nuptaria* Bremer, 1864, *Mem. Acad. Sci. St. Petersburg.* (7) 8 (1): 80, pl. 7: 5; Vojnits *et al.*, 1994: 17; Beljaev & Park, 1998: 253; Parson *et al.*, 1999: 263; Kim *et al.*, 2001: 170, pl. 18: 21; Kim *et al.*, 2016: 193, fig. 249.

*Eilicrinia ophthalmicata* Wehrli, 1927, in *Bang-Haas, Horae macrolepidopt. Reg. palaeact.* 1: 96, pl. 11, fig. 34.

**Specimens examined. KOREA:** 1♂, Prov. Gang-von district, On-dzong, Kum-gang san, near Hotel Go-song, 250 m, No. 325, 7. VIII. 1975, leg. J. Papp & A. Vojnits, slide HNHM2010–03675 (HNHM); 1♀, Prov. North Pyongar, Mt. Myohyang-san, Hotel Myohyang-san, No. 793, 14. II. 1982, leg. Dr. L. Forró & L. Ronkay, slide HNHM2010–03684 (HNHM). **TAIWAN:** 1♂, Hualien Co., Ci'en, 1,995 m, 13. VIII. 2012, S. Wu & W. C. Chang (TFRI); 2♀♀, same collecting locality, 25. V. 2012, S. Wu & W. C. Chang (TFRI).

**Distribution.** Russia, the Korean Peninsula (Kim *et al.*, 2001); Taiwan (new record).

**Note.** Having dissected the genitalia (of both sexes) of both Korean and Taiwanese specimens, no remarkable difference in morphology were observed. This species has a peculiar distribution pattern since currently there are no records from either China or Japan to fill the geographical gaps between Korea, Russia and Taiwan. The proposed recommended species common name refers to the generic common name, 蟠尺蛾, in Fang (2003) and the specific name, 뽕족귀무늬가지나방 (point-eared moth), in Kim *et al.* (2016).

***Apochima excavata* (Dyar, 1905)**

桑摺翅尺蛾

(Figs 1i, 2e)

*Acanthocampa excavata* Dyar, 1905, *Proc. U. S. natn. Mus.* 28: 952, figs 17, 18.

*Zamacra excavata*: Inoue, 1941: 27; Inoue, 1946: 45; Inoue, 1956: 339, no. 1695; Inoue, 1977: 305; Chu, 1981: 129.

*Apochima excavata*: Inoue, 1982: 554; Shin, 1983: 1001; Lu, 1991: 123, fig. 176; Kim & Shin, 1996: 19; Parsons *et al.*, 1999: 56; Kim *et al.*, 2001: 139, fig. 110, pl. 14: 19; Sato, 2011: 177, pl. 27:9, 10.

**Specimen examined. TAIWAN:** 1♂, Taoyuan County, Xicun, 1,106 m, 9. II. 2018, leg. B. Benedek (HNHM).

**Distribution.** Japan, Korea, China (Sato, 2011); Taiwan (new record).

**Bionomics.** This species is common outside of Taiwan, but within Taiwan, it appears to be rare, and is restricted to Northern Taiwan.

**Note.** The male genitalia of Taiwanese specimens are not distinctly different from those of Korean specimens (see Kim *et al.*, 2001: 139, fig. 110). The recommended generic and specific recommended common names follow Lu (1991).

***Apochima praeacutaria* (Inoue, 1976)**

尖嘴摺翅尺蛾\*、尖嘴尺蛾

(Fig. 1l)

*Zamacra praeacutaria*, Inoue, 1976, *Tinea* 10 (2): 21, text-fig. 3, fig. 39.

*Apochima praeacutaria*: Inoue, 1992: 116; Fu *et al.*, 1995: 22, pl. 1: 12; Wang, 1998: 267, figs.; Parsons *et al.*, 1999: 56; Sato, 2011: 178, pl. 27: 11, 12.

**Specimens examined. TAIWAN:** 1♂, Hsinchu, Jianshi, 1,000 m, 1. III. 2019, leg. S. Wu (TFRI); 1♀, Taichung Co., Baxianshan, 1,000 m, 8. III. 1994, leg. C. M. Fu (CCMF); 1♀, same collecting locality, 7. III. 1995, leg. C. M. Fu (CCMF); 1♂, same collecting locality, 16. III. 1996, leg. C. M. Fu (CCMF); 2♂♂, Taichung Co., Songhe, 1,469 m, 22. II. 2020, leg. C. C. Yang (TFRI); 1♂, Ilan Co., Fushan Botanical Garden, 15. III. 2014, leg. Y. B. Fan (TFRI); 1♂, Ilan Co., Mingchi, 28. II. 2016, leg. C. G. Lai (TFRI); 1♀, Hualien Co., Tiangxiang, 480 m, 25. III. 2017, leg. S. F. Lu (TFRI).

**Distribution.** Japan, Taiwan (Sato, 2011).

**Note.** The common name, 尖嘴尺蛾, was proposed by Wang (1998). We follow the generic common name in Lu (1991) and propose a new recommended species common name.

***Planociampa chlora* Yazaki & Wang, 2003**

綠朴尺蛾

(Figs 1j, 1k, 2f, 2j)

*Planociampa chlora* Yazaki & Wang, 2003, *Tinea* 17: 206, figs 12-14; Yazaki & Wang, 2011: 122, pl. 20: 6.

**Specimens examined. CHINA:** 1♂1♀, Guangdong, Shaoguan, Nanling, 700–1,200 m, 20-24. II. 2003 (NSMT). **TAIWAN:** 1♂, Hsinchu Co., Luoshan, 1,000 m, 24. III. 2018, leg. S. Wu & S. S. Wu (TFRI); 1♂, Kaohsiung Hsien [=Kaohsiung Co.], Terngjy, 1,550 m, 22. III. 1991, leg. H. Y. Wang (NMNS); 2♂♂, Ilan Co., Fushan Botanical Garden, 20–21. II. 2002, leg. S. S. Lu (TFRI); 3♂♂, same collecting locality, 12–20. II. 2003, leg. S. S. Lu (TFRI); 1♂1♀, same collecting locality, 31. I. 2010, leg. S. Wu (TFRI); 1♂, Taichung Co., Baxianshan, 1,000 m, 16. III. 1994, leg. C. M. Fu (CCMF); 1♀, same collecting locality, 7. III. 1995, leg. C. M. Fu (CCMF).

**Distribution.** Southern China (Yazaki & Wang, 2011); Taiwan (new record).

**Bionomics.** This species is distributed in low to mid-elevation broadleaf forests. The adults occur during January and March.

**Note.** The specimens from Taiwan and the type locality, “Mts Nanling”, China and Taiwan have been dissected for comparison, but there are no remarkable genitalic differences. The common name follows Yazaki & Wang (2011).

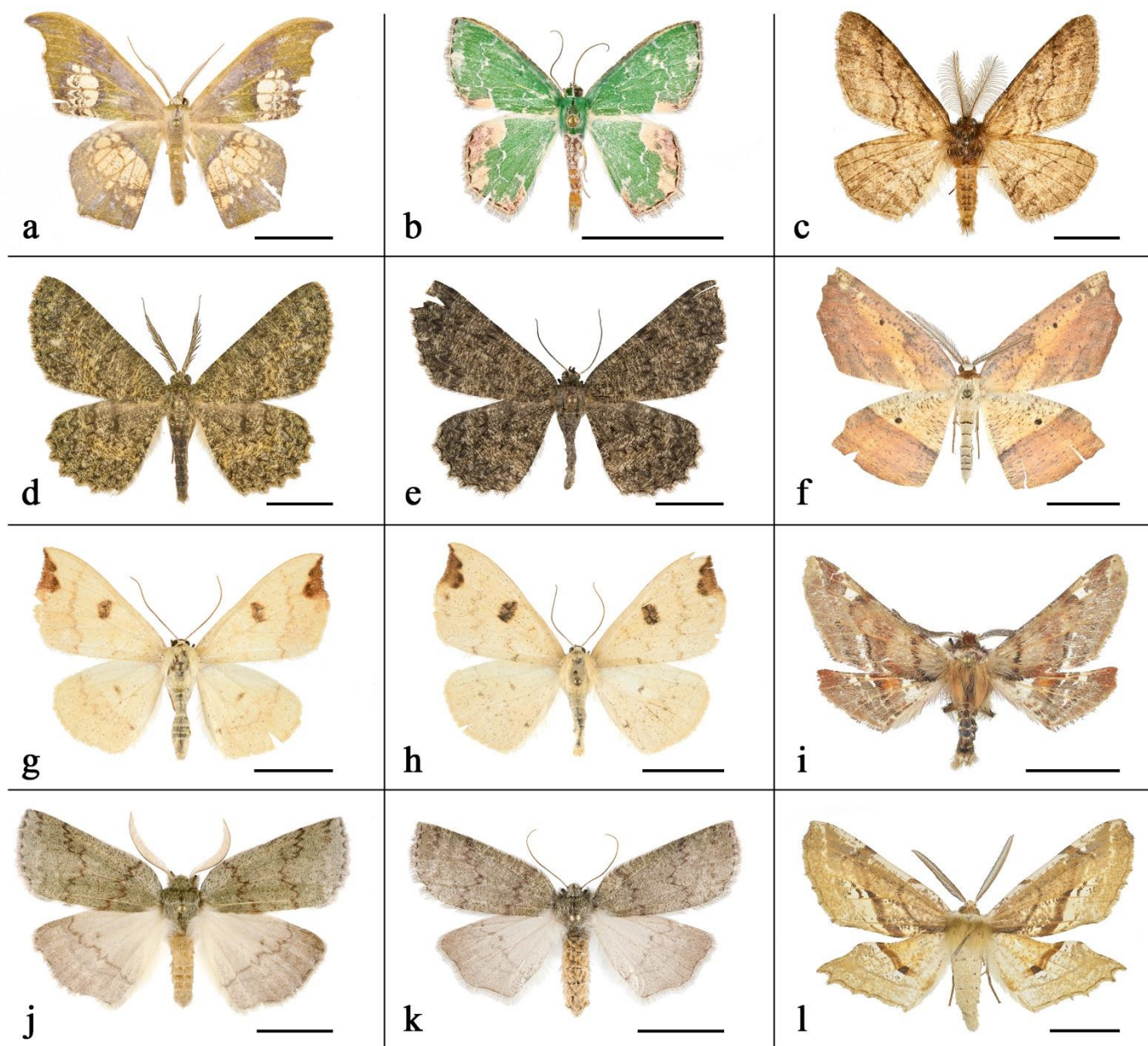


Figure 1. Habitus of geometrid moths of Taiwan. a. *Timandromorpha enervata* Inoue, 1944 ♂; b. *Eucyclodes infracta* (Wileman, 1911) ♂; c. *Megabiston plumosaria* (Leech, 1891) ♂; d. *Hypomecis hyposticta* (Wehrli, 1925) ♂; e. *Ditto* ♀; f. *Xyloscia dentifera* Inoue, 1986; g. *Eilicrinia nuptaria* Bremer, 1864 ♂; h. *Ditto* ♀; i. *Apochima excavata* (Dyar, 1905) ♂; j. *Planociampa chlora* Yazaki & Wang, 2003 ♂; k. *Ditto* ♀; l. *Apochima praeacutaria* (Inoue, 1976) ♂. Scale bar= 10 mm. Courtesy of specimens. TFRI (a, b, d, e–h, j–l), NTM (c), HNHM (i). Photo by Shipher Wu.



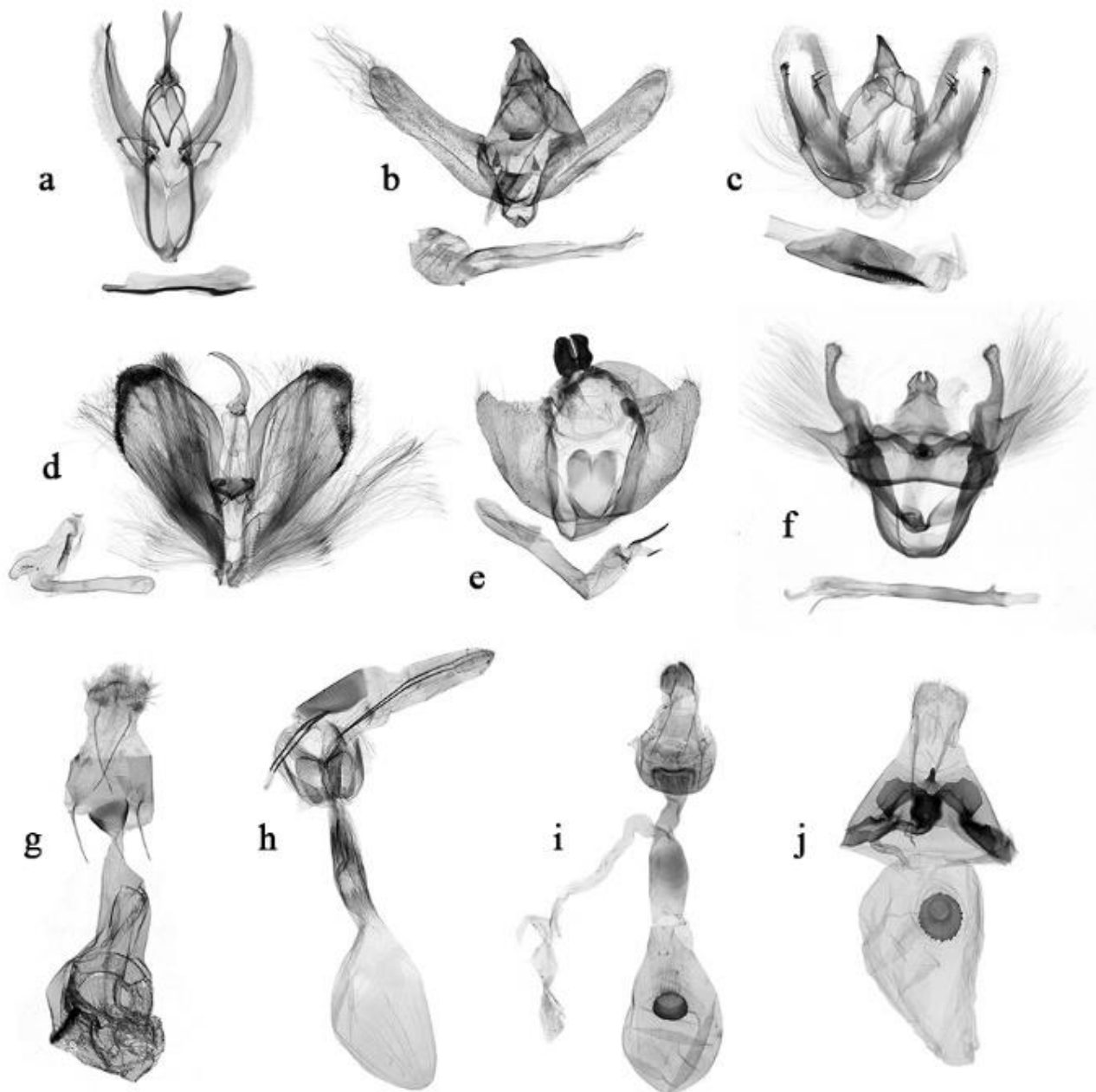


Figure 2. Genitalia of geometrid moths of Taiwan. a. *Eucyclodes infracta* (Wileman, 1911) ♂; g. *Ditto* ♀; b. *Megabiston plumosaria* (Leech, 1891) ♂; c. *Hypomecis hyposticta* (Wehrli, 1925) ♂; h. *Ditto* ♀; d. *Eilicrinia nuptaria* Bremer, 1864 ♂; i. *Ditto* ♀; e. *Apochima excavata* (Dyar, 1905) ♂; f. *Planociampa chlora* Yazaki & Wang, 2003 ♂; j. *Ditto* ♀. Courtesy of specimens. TFRI (a, c, d, f–j), NTM (b), HNHM (e). Photo by Shipher Wu.

### Discussion

The mid-to-high elevation geometrid fauna of Taiwan have been investigated since the beginning of 20<sup>th</sup> century, e.g. Fu and Tzuoo (2002; 2004) and Fu *et al.* (2013). The species recorded in this study were mainly collected below 2,000 meters. Among them, *E. infracta* is restricted to Northern Taiwan, and *H. hyposticta* is restricted in Southeastern Taiwan. Three newly recorded species, i.e. *M. plumosaria*, *A. excavata*, and *P. chlora* have only one generation in other distributional regions and are on the wing in colder seasons. In order to better understand the Taiwanese geometrid fauna, further studies are required in those areas which have been poorly-sampled, as well as sampling throughout the year.

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## 臺灣產少見種與新紀錄種尺蛾註記（鱗翅目：尺蛾科），第一部

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**摘要:** 本研究為釐清臺灣產少見與新紀錄種尺蛾科物種的系列文章第一部分。包含九個物種，其中六種為新紀錄種，即彎彩翠尺蛾 *Eucyclodes infracta* (Wileman, 1911)、羽蠶尺蛾 *Megabiston plumosaria* (Leech, 1891)、墨褐尺蛾 *Hypomecis hyposticta* (Wehrli, 1925)、尖耳蟠尺蛾 *Eilicrinia nuptaria* Bremer, 1864、桑摺翅尺蛾 *Apochima excavata* (Dyar, 1905)、綠朴尺蛾 *Planociampa chlora* Yazaki & Wang, 2003。四物種，即墨褐尺蛾、銳齒木尺蛾 *Xyloscia dentifera* Inoue, 1986、尖耳蟠尺蛾與尖嘴摺翅尺蛾 *A. praeacutaria* (Inoue, 1976) 提供新稱建議中文名與註記。

**關鍵詞:** 生物相、物種豐度、大陸型島嶼、東方區、印澳區