

Four New Records of the Larentiinae (Lepidoptera, Geometridae) from Korea

Bora Shin¹, Sung-Soo Kim², Sei-Woong Choi^{3,*}

¹Department of Biology, Mokpo National University, Muan 58554, Korea

²Research Institute for East Asian Environment and Biology, Seoul 05264, Korea

³Department of Environmental Education, Mokpo National University, Muan 58554, Korea

ABSTRACT

We report four larentiine moths, *Acolutha pulchella* (Hampson), *Eupithecia tantilloides* Inoue, *Gymnoscelis taprobanica* Prout, and *Axinoptera anticostalis* Galsworthy for the first time in Korea. *Acolutha pulchella* can be easily diagnosed by the orange-colored costal half of the forewing with a thick blackish postmedial band and the yellowish-white hindwing with blackish undulating medial lines. *Eupithecia tantilloides* can be diagnosed by the relatively thick, blackish postmedial line and a large black discal dot on forewing. *Gymnoscelis taprobanica* can be diagnosed by the slender forewing with a pointed apex with a weakly undulating postmedial line and the dark grayish hindwing with a blackish horizontal line. *Axinoptera anticostalis* can be diagnosed by the strongly rounded postmedial line and a blackish horizontal line at the dorsal part of the central fascia of the forewing and the strongly curved postmedial line and yellowish white marking at mid termen of the hindwing. We provide the diagnosis, and photographs of adults and the genitalia of these species as well as the mitochondrial COI gene sequence.

Keywords: new record, Larentiinae, Korea, *Acolutha*, *Eupithecia*, *Gymnoscelis*, *Axinoptera*

INTRODUCTION

The subfamily Larentiinae is the second largest geometrid moth with more than 6,200 species worldwide (Hausmann and Viidalepp, 2012), and diverse in the temperate and high elevation in the tropics (Minet and Scoble, 1999). The main characters to define this subfamily are the forewing pattern with multiple transverse lines, the venation of the hindwing with a long anastomosis of Sc + R₁ and R_s, and the hammer-shaped tip of ansa in the tympanal organ (Hausmann and Viidalepp, 2012). The monophyly of the subfamily was well-defined based on morphology and molecular data sets (Öunap et al., 2016; Brehm et al., 2019; Murillo-Ramos et al., 2019). Most moths in this subfamily are nocturnal, but some brightly colored larentiines fly during the day (Öunap et al., 2016). The evolutionary factors driving the shift from nocturnal to diurnal behavior remain unknown, but diurnal larentiines typically have brightly colored wings, while their nocturnal relatives often exhibit cryptic coloration (Öunap et al., 2016).

In Korea, the subfamily Larentiinae comprises more than

250 species (Kim et al., 2016, 2018; Tóth et al., 2018). The purpose of the present study was to describe four species of the Larentiinae, *Acolutha pulchella* (Hampson, 1891), *Eupithecia tantilloides* Inoue, 1958, *Gymnoscelis taprobanica* Prout, 1958, and *Axinoptera anticostalis* Galsworthy, 1999 for the first time in Korea.

MATERIALS AND METHODS

We collected moths using a 22-watt UV-light bucket trap with a 12 V battery (BioQuip, USA) during the night. The collected moths were brought to the lab, where they were preserved in a freezer and mounted for examination. To accurately identify the species, morphological identification was conducted by examining the male and female genitalia. The genitalia slide was made by boiling the abdomen in a 10% potassium hydroxide (KOH) solution for about 20 min. After removing the scales and tissues, it was stained with Chlorazol Black and mounted on slides using an Euparal solution.

DNA from a 658 bp segment of the COI (cytochrome c oxi-

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

***To whom correspondence should be addressed**

Tel: 82-61-450-2783, Fax: 82-61-453-4843
E-mail: choisw@mokpo.ac.kr

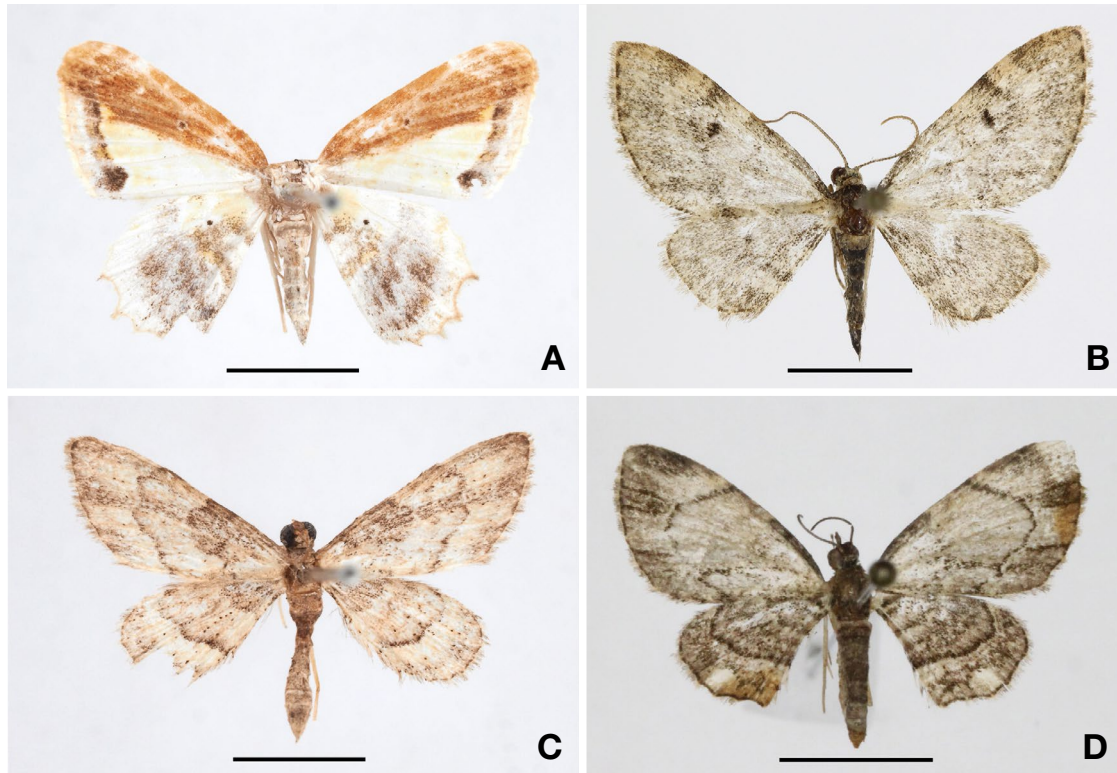


Fig. 1. Adults of Larentine moths from Korea. A, *Acolutha pulchella* (Hampson, 1891); B, *Eupithecia tantilloides* Inoue, 1958; C, *Gymnoscelis taprobanica* Prout, 1958; D, *Axinoptera anticostalis* Galsworthy, 1999. Scale bars: A–D=5 mm.

dase I) gene was extracted from one to three legs of specimen using the primer set LCO1490 and HCO2198, according to the Choi et al. (2024) gene analysis protocol. DNA barcodes for the available species were compared with related species using MEGA 11 (Tamura et al., 2021) to detect genetic differences. The sequence divergences for the barcode region were calculated using the Kimura 2 Parameter model, and intra-species and inter-species genetic distances were determined using the DNA sequences reported in GenBank (<https://www.ncbi.nlm.nih.gov/genbank>).

The examined specimens have been deposited in the insect collection of Mokpo National University, Jeollanam-do, and the National Institute of Biological Resources, Incheon, South Korea. Abbreviations used are as follows: TS, type species; TL, type locality, JN, Jeollanam-do; JJ, Jeju-do.

SYSTEMATIC ACCOUNTS

Order Lepidoptera Linnaeus, 1758
 Family Geometridae Leach, 1815
 Subfamily Larentiinae Duponchel, 1845

Korean name: ¹*앞주홍물결자나방 (신칭)

Genus *Acolutha* Warren, 1894

Acolutha Warren, 1894: 393. TS: *Emmelesia pictaria* Moore, 1887.

¹**Acolutha pulchella* (Hampson, 1891) (Figs. 1A, 2A, B)
Hyria pulchella Hampson, 1891: 124, pl. 153, f. 22. TL: India, Nilgiri District.

Cambogia pulchella: Hampson, 1895: 420.

Acolutha pulchella: Prout, 1930: 133.

Acolutha interposita Prout, 1935: 229. TL: Java (east), Nongkodjar.

Material examined. Korea: 1 male (head missing), JJ: Jeju-si, Andeok-myeon, 1 Mar 2019, Kim SS.

Diagnosis. This species can be easily diagnosed by the orange-colored costal half of the forewing with a thick blackish postmedial band and the yellowish-white hindwing with blackish undulating medial lines. This species is externally similar to *A. pictaria* (Moore, 1888) but can be easily distinguished by the orange-colored costa of the forewing and blackish undulating medial lines of the hindwing. The male genitalia of *A. pulchella* are similar to those of *A. pictaria* but

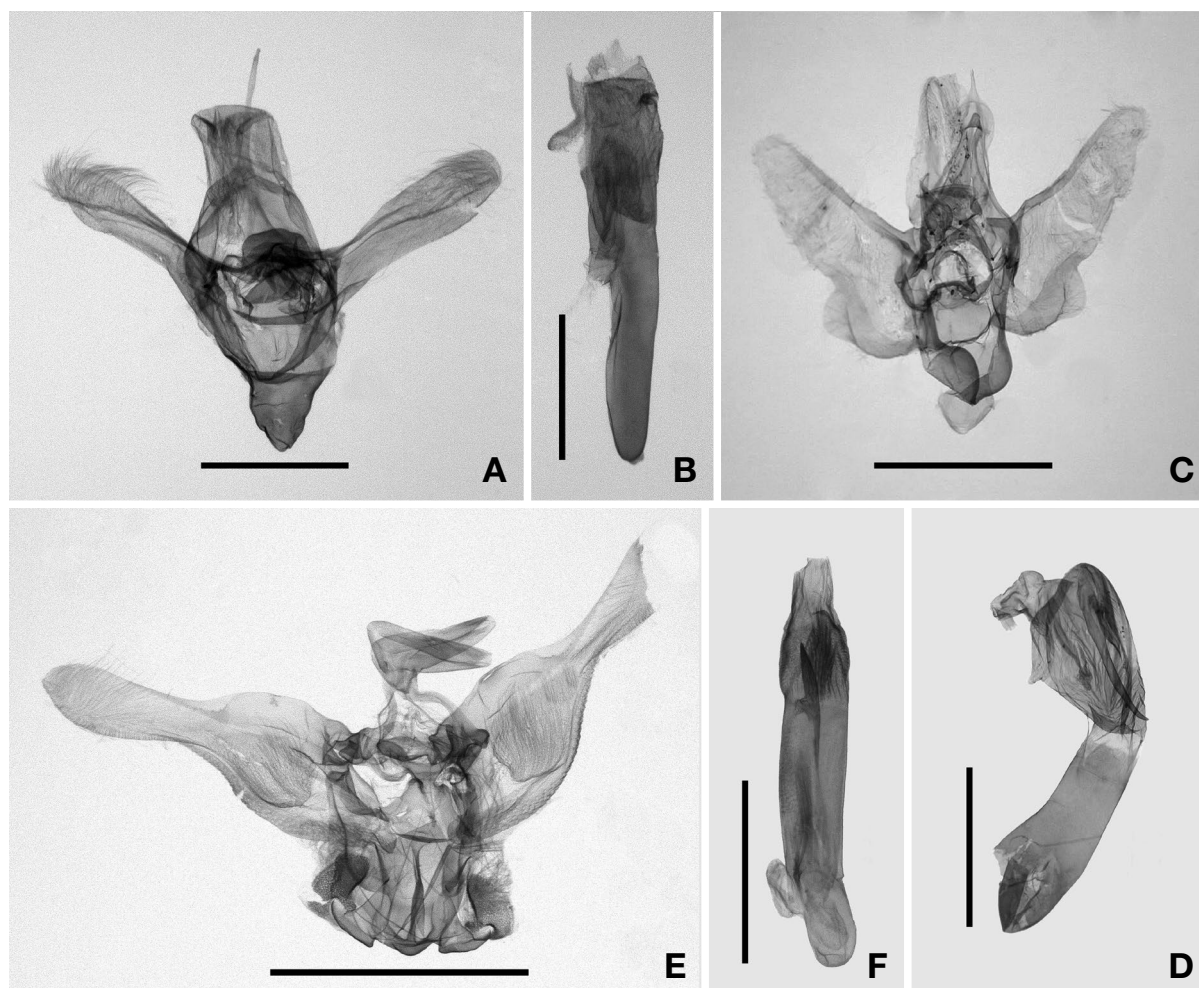


Fig. 2. Male genitalia of the Larentiine moths from Korea. A, B, *Acolutha pulchella* (Hampson, 1891); C, D, *Eupithecia tantilloides* Inoue, 1958; E, F, *Gymnoscelis taprobanica* Prout, 1958. Scale bars: A–F=1 mm.

can be distinguished by the relatively thick, pad like valva with incurved sacculus and the medially projected saccus.

Description. Wingspan 18 mm. Body covered with whitish hairs; legs whitish with white tibial joints. Forewing ground color white, tinted with yellow, costal half of the forewing orange colored with a small black discal dot; subtermen with a thick blackish band, dorsally large black dot; underside costal half dark grayish and grayish subterminal line. Hindwing ground color yellowish white, dorsally tinged with black; basal line thick, blackish; discal dot small, black; medial lines blackish, thick, undulating; outer margin dorsally strongly crown-shaped; underside whitish, with large, broad, grayish medial band. **Male genitalia.** Uncus long, slender; subscaphium broad, weakly sclerotized; tegumen as long as vinculum; sacculus long, triangular. Valva long, slender, and membranous. Aedeagus long, tubular; vesica with minute spicules.

Distribution. Korea, Japan, China (Taiwan), Singapore, Thai-

land, India, Bhutan, and Sri Lanka.

Remarks. The members of the genus *Acolutha* are easily diagnosed by their wing ground color and the thick postmedial lines of wings. The male genitalia are diagnosed by the simple, slender uncus, the broadly scobinate subscaphium, the well-developed saccus, the elongated valva with setae on the inner lamina and a line of larger setae at the base of the sacculus, and the aedeagus with a minute or often the bands of slightly larger spines. The female genitalia can be diagnosed by the globular corpus bursae with dense spicules and the short, partly sclerotized ductus bursae (Holloway, 1997). The systematic position of the genus is undefined.

Genus *Eupithecia* Curtis, 1825

Eupithecia Curtis, 1825: 64. TS: *Phalaena absinthiata* Clerck, 1759.

¹**Eupithecia tantilloides* Inoue, 1958 (Figs. 1B, 2C, D)
Eupithecia tantilloides Inoue, 1958: 250. TL: Japan.

Material examined. Korea: 1 male, JN: Gurye-gun, Tojimycheon, Mt. Jirisan, 127°33'09"N, 35°183'01"E, 1,371 m, 8 Jun 2019, Choi SW.

Diagnosis. *Eupithecia tantilloides* can be diagnosed by the relatively thick, blackish postmedial line and a large black discal dot on the forewing. This species is externally similar to *E. emanata* Dietze, 1908 but can be distinguished by the position of the discal dot that is closer to the postmedial line of the forewing. The male genitalia of *E. tantilloides* can be easily diagnosed by the large sacculus basally with a large bump-shaped process. The male genitalia of *E. tantilloides* are similar to those of *E. emanata* but can be distinguished by the slender valva.

Description. Wingspan 19 mm. Male antennae filiform; frons rectangular, covered with yellowish-white hairs; labial palpi well projected beyond frons, mixed with brown and yellowish white scales, long about 1.5 times to eye diameter. Body covered with bright whitish hairs; legs brown with yellowish white joints. Forewing ground color light brownish or grayish, basal part blackish; antemedial line blackish, strongly undulating; postmedial line relatively thick, blackish, subcosta outwardly projected; discal dot large, black, close to the postmedial line; subterminal line thick, blackish, undulating; underside light brownish with costally blackish postmedial line, a large black discal dot, and dark grayish subterminal line. Hindwing ground color light brown; postmedial line thick, blackish, medially weakly projected; discal dot small, black; termen blackish; underside light grayish with a dark grayish discal dot, postmedial line, and subterminal line. **Male genitalia.** Uncus relatively short, less than half of tegumen, basally tapering; subscaphium long, strongly sclerotized; saccus broad. Valva basally broad, distally reduced; costa slender; sacculus basally with large bump-shaped process. Aedeagus stout; vesica with a long, sclerotized sword-shaped cornutus and a triangular sclerotized plate.

Distribution. Korea, Japan, and Russian Far East.

Remarks. The genus *Eupithecia* Curtis is the largest taxon in Lepidoptera, comprising more than 1,500 species worldwide. They are diagnosed by the grayish and brownish forewing with basal, ante- and postmedial transverse lines and a definite discal spot on the forewing. Kim et al. (2016) listed 49 species of *Eupithecia* and Tóth et al. (2018) added two species, *E. inturbata* (Hübner) and *E. calginea* Butler. Therefore, a total of 52 species are known in Korea, including *E. tantilloides*.

Mironov and Galsworthy (2014) combined two species groups, lanceata and tantillaria group, the latter group includes

E. tantilloides, into lanceata-group and provided the diagnostic characters of the male and female genitalia: the highly sclerotized and modified sacculus with one or two ventral processes; the stout aedeagus with one or more large cornuti; the corpus bursae with one or more rows of stout spines and additional field of smaller spines; and the spineless diverticulum at base.

DNA barcoding. The DNA barcode of *Eupithecia tantilloides* was first registered in this study (GenBank accession No. PP442156), and the p-distance with *E. alpinata* (BOLD Sequence ID: LNAUT3556-15) was 5.35%.

Genus *Gymnosceis* Mabille, 1868

Gymnosceis Mabille, 1868: 656. TS: *Geometra pumilata* Hübner, 1813.

= *Doleroscelis* Meyrick, 1889: 480. TS: *Eupithecia erymna* Meyrick, 1886.

= *Iramba* Moore, [1887]: 480. TS: *Iramba tibialis* Moore, [1887].

Gymnoscelis taprobanica Prout, 1958

(Figs. 1C, 2E, F, 3A)

Gymnoscelis mesophoena taprobanica Prout, 1958: 443. TL: Ceylon.

Gymnoscelis taprobanica: Holloway, 1997: 167.

Material examined. Korea: 1 male, JJ: Jeju-si, Gwanumsa temple, 18 Sep 1996, Kim SS; 1 female JN: Goheung-gun, Bongnae-myeon, Yena-ri, 34°26'8"N, 127°30'24.7"E, 30 Jul 2021, Choi SW.

Diagnosis. *Gymnoscelis taprobanica* can be diagnosed by the slender forewing with a pointed apex with a weakly undulating postmedial line and the dark grayish hindwing with a blackish postmedial line. *G. taprobanica* is externally similar to *G. deleta* (Hampson, 1891) but can be distinguished by the strongly projected costal part of postmedial line and projected apex of the forewing. The male genitalia of *G. taprobanica* can be distinguished from those of *G. deleta* by the large curved subscaphium and the largely expanded sacculus of valva and the large spear-shaped cornutus on the vesica.

Description. Wingspan 14–15 mm. Male and female antennae filiform; frons mixed with brown and dark ochreous scales; labial palpi long, about twice to eye diameter, strongly projected beyond frons, almost porrect, 3rd segment short, white. Body and legs covered with bright whitish scales. Forewing ground color dark grayish, apex projected; antemedial lines blackish, undulating, costally thick and more projected; postmedial line blackish, undulating, costally and medially weakly projected; termen dark grayish; underside distinct with dark

Korean name: ¹*점애기물결자나방 (신칭)

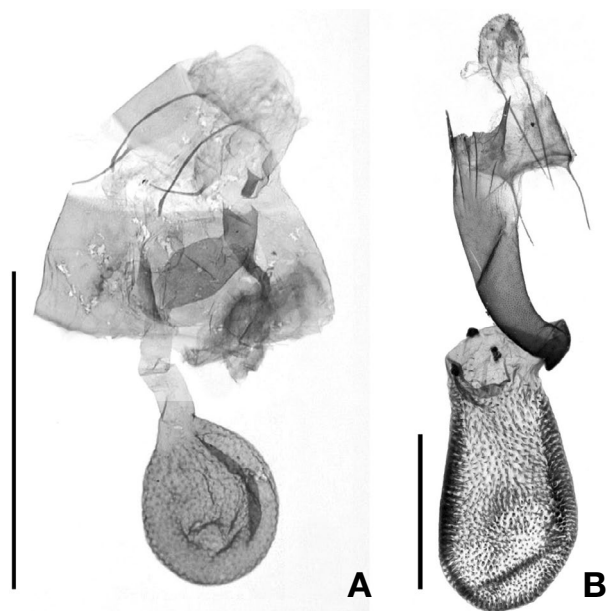


Fig. 3. Female genitalia of the Larentiine moths from Korea. A, *Gymnoscelis taprobanica* Prout, 1958; B, *Axinoptera anticostalis* Galsworthy, 1999. Scale bars: A, B = 1 mm.

grayish postmedial line. Hindwing ground color dark grayish; basal part blackish with an undulating line; postmedial line blackish, undulating; subterminal line blackish, weakly undulating; underside distinct with light blackish postmedial line.

Male genitalia. Uncus absent; subscaphium well-developed, long, curved, tubular; saccus broad, laterally with a pair of large coremata pouches. Valva basally broad, distally reduced; costa basally expanded; sacculus basally expanded. Aedeagus long; vesica with a spear-shaped cornutus with several sclerotized spines. **Female genitalia.** Papilla anales broad; anterior apophyses 1/3 of posterior apophyses in length. Ostium bursae simple; ductus bursae long, tubular; corpus bursae ovate, densely filled with spicules.

Distribution. Korea, China (south), Hong Kong, Philippines, India, Sri Lanka.

Remarks. The genus comprises approximately 90 species worldwide and shows high species richness in the Indo-Australian region (Holloway, 1997). In Korea, three species of *Gymnoscelis* are known, including *G. taprobanica* (Choi, 2008).

DNA barcoding. We obtained the DNA barcode of *Gymnoscelis taprobanica* from a single female specimen collected in Korea (GenBank accession No. PP442157). The intraspecific p-distance within *G. taprobanica* (GenBank accession No. PP273934) was 1.09%, while the average p-distance between *G. taprobanica* and its close relative *Chloroclystis approxi-*

mata (Walker, 1869) was 8.68% (n = 4, ±0.10 SD). Although this species is morphologically very similar to *C. pyrrollopha* Turner, 1907, making it difficult to distinguish, it is genetically differentiated with an average p-distance of 11.39% (n = 3, ±0.17 SD).

Genus *Axinoptera* Hampson, 1893

Axinoptera Hampson, 1893: 154. TS: *Axinoptera subcostalis* Hampson, 1893.

¹**Axinoptera anticostalis* Galsworthy, 1999 (Figs. 1D, 3B)

Axinoptera anticostalis Galsworthy, 1999: 230. TL: China, Ding Fu Shan (Gwangdong).

Material examined. Korea: 1 female, JN: Shinan-gun, Anjwa-myeon, Dae-ri, 34°42'43.16"N, 126°9'21.17"E, 19 May 2023, Choi SW.

Diagnosis. *Axinoptera anticostalis* can be diagnosed by the strongly rounded postmedial line and a blackish horizontal line at the dorsal part of the central fascia of the forewing and the strongly curved postmedial line and yellowish white marking at mid termen of the hindwing. *Axinoptera anticostalis* is externally similar to *A. fasciata* (Warren, 1906) but can be easily distinguished by the smooth and largely rounded postmedial line of the forewing. The female genitalia of *A. anticostalis* can be distinguished by the strongly sclerotized ductus bursae that anteriorly strongly coiled and posteriorly projected lateral processes.

Description. Wingspan 16 mm. Female antennae filiform; frons covered with dark brown hairs; labial palpi long almost twice eye diameter, well projected beyond frons, upturned, dark brownish. Body covered with bright white hairs; legs whitish with light yellowish tibial joints. Forewing ground color blackish; basal part blackish; antemedial line black; postmedial line black, medially largely projected; central fascia grayish, subdorsal with a black horizontal line connecting ante- and postmedial lines; termen blackish, with black horizontal lines on the veins; underside grayish with a medially strongly projected postmedial line. Hindwing ground color blackish; basal line black, straight, about four medial straight lines; postmedial line blackish, rounded, costally strongly projected; termen with double dentate blackish lines with a large whitish marking; underside dark grayish with blackish subterminal line. **Male genitalia** (based on Galsworthy, 1999). Uncus short; subscaphium developed; tegumen 1.5 times longer than vinculum; saccus short, broad. Valva divided, apex sharply pointed; costa long slender; sacculus distally strongly reduced. **Female genitalia.** Papillae anales projected; posterior apophyses long twice to anterior apophyses. Ostium bursae with broad antrum

Korean name: ¹*볼록검은줄물결자나방 (신칭)

and sharply pointed lateral process; ductus bursae long, sclerotized, posteriorly wide, anteriorly strongly twisted; corpus bursae long, sac-shaped, and wall densely filled with long spicules.

Food plants. Galsworthy (1999) reported the type specimen reared from *Glochidion ericarpum* Champ. ex Benth. (Euphorbiaceae).

Distribution. Korea, Japan, China (Hong Kong, Guangdong, Yunnan, Taiwan), India, and Bhutan.

Remarks. The genus *Axinoptera* can be diagnosed by the centrally strongly curved postmedial line of the forewing and the pale patch near the margin between veins M_3 and CuA_1 of the hindwing. The male genitalia of the genus showed the spine-like sacculus process, small scent pencils at the base of the sacculus, and one to several large cornuti on the vesica. The female genitalia of the genus showed the lateral groups of spines or scobination on the ventral margin of the ostium, the long, relatively broad, sclerotized ductus bursae, and ovate corpus bursae with basally sclerotized portion and wall densely covered with spines (Holloway, 1997). The genus comprises more than 10 species worldwide (Holloway, 1997; Galsworthy, 1999), and one species of the genus is known in Korea.

DNA barcoding. The DNA barcode of *Axinoptera anticostalis* was first registered in this study (GenBank accession No. PP442161), and the p-distance with *A. fasciata* (GenBank accession No. KR070785) was 5.03%.

ORCID

Bora Shin: <https://orcid.org/0000-0002-0081-0711>

Sung-Soo Kim: <https://orcid.org/0000-0001-5693-4142>

Sei-Woong Choi: <https://orcid.org/0000-0001-6326-399X>

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGMENTS

We thank Dr. Galsworthy and Dr. Beljaev for the discussion on the species of *Gymmoscelis*. The study was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR202304203, NIBRE202405).

REFERENCES

- Brehm G, Murillo-Ramos L, Sihvonen P, Hausmann A, Schmidt BC, Öunap E, Moser A, Mörtter R, Bolt D, Bodner F, Lindt A, Parra LE, Wahlberg N, 2019. New World geometrid moths (Lepidoptera: Geometridae): molecular phylogeny, biogeography, taxonomic updates and description of 11 new tribes. *Arthropod Systematics and Phylogeny*, 77:457-486. <https://doi.org/10.26049/ASP77-3-2019-5>
- Choi SW, 2008. Taxonomic review of *Gymmoscelis* Mabille (Lepidoptera: Geometridae) from Korea. *Entomological Research*, 38:69-72. <https://doi.org/10.1111/j.1748-5967.2008.00133.x>
- Choi SW, Shin B, Lee JY, Kim SS, 2024. A new record of Epipleminae (Lepidoptera, Uraniidae) from Korea. *Animal Systematics, Evolution and Diversity*, 40:112-114. <https://doi.org/10.5635/ASED.2024.40.1.025>
- Clerck CA, 1759. *Icones Insectorum rariorum*. Holmiae, pp. XII + III.
- Curtis J, 1825. *British Entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland: containing coloured figures from nature of the most rare and beautiful species, an in many instances of the plants upon which they are found*. Vol. 2. The Author, London, pp. 1-64.
- Duponchel MPAJ, 1845. *Catalogue méthodique des lépidoptères d'Europe: distribués en familles, tribu et genres*. Méquignon-Marvis fils, Paris, pp. 1-583.
- Galsworthy AC, 1999. New and revised eupitheciine species (Geometridae, Larentiinae) from Hong Kong and South East Asia. *Transactions of the Lepidopterological Society of Japan*, 50:223-234. https://doi.org/10.18984/lepid.50.3_223
- Hampson GF, 1891. *Illustrations of typical specimens Heterocera in the Collection of the British Museum. Part VIII: The Lepidoptera Heterocera of the Nilgiri District*. Taylor & Francis, London, pp. 1-144.
- Hampson GF, 1893. *Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum. Part 9. The macrolepidoptera heterocera of Ceylon. Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum*, 9:1-182.
- Hampson GF, 1895. *Fauna of British India, including Ceylon and Burma. Moths*. Vol. III. Taylor and Francis, London, pp. 1-546.
- Hausmann A, Viidalepp J, 2012. Larentiinae 1. In: *Geometrid moths of Europe*. Vol. 3 (Ed., Hausmann A). Apollo Books, Stenstrup, pp. 1-743.
- Holloway JD, 1997. The moths of Borneo. Part 10. Geometridae, subfamilies Sterrhinae and Larentiinae. *Malayan Nature Journal*, 51:1-242.
- Hübner J, 1809-1813. *Sammlung europäischer Schmetterlinge*. Geometrae. Ausburg, pp. 1-24.
- Inoue H, 1958. Descriptions and records of some Japanese Geometridae (Lepidoptera: Geometridae). *Tinea*, 4:241-256.
- Kim NH, Choi SW, Kim SS, 2018. Additional report of the genus

- Asthen* (Lepidoptera: Geometridae) from Korea. *Animal Systematics, Evolution and Diversity*, 34:92-95. <https://doi.org/10.5635/ASED.2018.34.2.016>
- Kim SS, Choi SW, Sohn JC, Kim T, Lee BW, 2016. The Geometrid moths of Korea (Lepidoptera: Geometridae). Jung-haengsa, Seoul, 499pp.
- Leach WE, 1815. Entomology. In: The Edinburgh encyclopedia, Vol. 9 (Ed., Brewster D). William Blackwood, Edinburgh, pp. 57-172.
- Linnaeus C, 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. editio decima, reformata*. 10th revised ed. Vol. 1. Laurentius Salvius, Holmiae, pp. 1-824.
- Mabille P, 1868. Notices sur les Lépidoptères de la Corse avec une énumération monographique des Eupithécies de la Corse (2e Notice). *Annales de la Société Entomologique de France*, 7:635-658.
- Meyrick E, 1886. Descriptions of Lepidoptera from the South Pacific. *Transactions of the Entomological Society of London*, 34:189-296. <https://doi.org/10.1111/j.1365-2311.1886.tb01626.x>
- Meyrick E, 1889. On some Lepidoptera from New Guinea. *Transactions of the Entomological Society of London*, 37:455-522. <https://doi.org/10.1111/j.1365-2311.1889.tb00932.x>
- Minet J, Scoble MJ, 1999. The Drepanoid/Geometroid assemblage. In: *Handbuch der zoologie, Band IV Arthropoda: Insecta, Teilband 35, Lepidoptera, moths and butterflies, Vol. 1. Evolution, systematics, and biogeography* (Ed., Kristensen NP). Walter de Gruyter, Berlin & New York, pp. 301-320.
- Mironov V, Galsworthy A, 2014. *The Eupithecia of China*. Brill, Leiden, pp. 1-491.
- Moore F, 1887. *The Lepidoptera of Ceylon*. Vol. 3. L. Reeve and Co., London, pp. 305-578.
- Murillo-Ramos L, Brehm G, Sihvonen P, Hausmann A, Holm S, Ghanavi HR, Öunap E, Truuverk A, Stauder H, Friedrich E, Tammaru T, Wahlberg N, 2019. A comprehensive molecular phylogeny of Geometridae (Lepidoptera) with a focus on enigmatic small subfamilies. *PeerJ*, 7:e7386. <https://doi.org/10.7717/peerj.7386>
- Öunap E, Viidalepp J, Truuverk A, 2016. Phylogeny of the subfamily Larentiinae (Lepidoptera: Geometridae): integrating molecular data and traditional classifications. *Systematic Entomology*, 41:824-843. <https://doi.org/10.1111/syen.12195>
- Prout LB, 1930. A catalogue of the Lepidoptera of Hainan. *The Bulletin of the Hill Museum*, 4:125-256.
- Prout LB, 1935. New Geometridae from East Java. *Novitates Zoologicae*, 39:221-238.
- Prout LB, 1958. New species of Indo-Australian Geometridae. *Bulletin of the British Museum (Natural History) Entomology*, 6:367-463. <https://doi.org/10.5962/bhl.part.17111>
- Tamura K, Stecher G, Kumar S, 2021. MEGA11: Molecular Evolutionary Genetics Analysis version 11. *Molecular Biology and Evolution*, 38:3022-3027. <https://doi.org/10.1093/molbev/msab120>
- Tóth B, Katona G, Bálint Z, 2018. Data of Geometridae (Lepidoptera) from the Korean Peninsula in the collections of the Hungarian Natural History Museum - subfamily Larentiinae. *Folia Entomologica Hungarica*, 79:127-161. <https://doi.org/10.17112/FoliaEntHung.2018.79.127>
- Warren W, 1894. New genera and species of Geometridae. *Novitates Zoologicae*, 1:366-466. <https://doi.org/10.5962/bhl.part.24566>

Received September 20, 2024
Revised October 16, 2024
Accepted October 20, 2024