

The Genus *Cameraria* Chapman, 1902 (Lepidoptera: Gracillariidae: Lithocolletinae), New to Korea

Da-Som Kim, Neung-Ho Ahn¹ and Bong-Kyu Byun^{2*}

Basic Science Division, National Science Museum of Korea, Daejeon 34143, Korea

¹Genetic Resources Information Center, National Institute of Biological Resources, Incheon 22689, Korea

²Department of Biological Science and Biotechnology, Hannam University, Daejeon 34054, Korea

한국미기록 *Cameraria*屬 (나비목: 가는나방과: 가는나방아과)의 3未記錄種 보고

김다솜 · 안능호¹ · 변봉규^{2*}

국립중앙과학관 기초과학과, ¹국립생물자원관 유전자원정보관리센터, ²한남대학교 생명시스템과학과

ABSTRACT: In this study, the genus *Cameraria* Chapman, 1902 belonging to the family Gracillariidae is reported for the first time from Korea, with three newly recorded species, *Cameraria acericola* Kumata, 1963, *C. hikosanensis* Kumata, 1963 and *C. nipponica* Kumata, 1963. All the known Korean species are enumerated with their available information. Adults and genitalia of all species are redescribed and illustrated.

Key words: Lithocolletinae, New record, Leaf-miner, *Cameraria*, Taxonomy

초록: 본 연구를 통해 가는나방과의 *Cameraria*屬이 우리나라에서 처음으로 보고되며, 본屬의 3종 <*Cameraria acericola* Kumata, 1963 (탈고로쇠 가는나방), *C. hikosanensis* Kumata, 1963 (달팽나무가는나방) 및 *C. nipponica* Kumata, 1963 (청시닥가는나방)>이 한국미기록종으로 기록된다. 본 연구에서 보고되는 모든 종에 대한 분류 및 기주식물 정보를 종합하여 정리하였으며 성충 및 생식기의 특징을 도해와 함께 재기재하였다.

검색어: 가는나방아과, 미기록종, 잠엽성, *Cameraria*속, 분류학

In Korea, 74 species belonging to 16 genera of the family Gracillariidae have been reported to date (Byun et al., 2009; Shin et al., 2015; Kim and Byun, 2016, 2017, 2019, 2022; Lee et al., 2017; Lee and Jeun, 2022). The genus *Cameraria* Chapman, 1902 is one of the smaller genera in the subfamily Lithocolletinae, comprising only 100 species worldwide (De Prins and De Prins, 2006-2021). All members of the genus are distributed exclusively in the Afrotropical, Nearctic, Oriental, and Palearctic

regions (De Prins and De Prins, 2006-2021). Sometimes, the leaf-miners appear as an important economic pest with their economical traits to mine into leaves during their larval stage. For example, *Cameraria ohridella* is the most famous insect, which causes significant damage to horse chestnut trees in Europe (Deschka and Dimic, 1986).

The aim of the present study is to report the genus *Cameraria* for the first time from Korea with three newly recorded species, including brief redescription and illustration.

*Corresponding author: bkbyun@hnu.kr

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Materials and Methods

The specimens examined in this study were deposited in the Systematic Entomology Laboratory, Hannam University, Daejeon, Korea (HNUSEL). Male and female genitalia were dissected and mounted with Euparal solution, following the procedure described in Holloway et al. (1987). Images of the adults were taken using a digital camera (Canon EOS 600D, Canon Inc., Ota, Tokyo, Japan) and images of genitalia were captured using a digital camera attached on the microscope, LEICA M205C (© Leica Microsystems, Wetzlar, Hesse, Germany) and refined in Photoshop CS5 software.

Abbreviations in this study for locality in Korea are as follows: GG (Gyeonggi-do), GB (Gyeongsangbuk-do), CN (Chungcheongnam-do), JB (Jeollabuk-do), JN (Jeollanam-do), TL (Type locality), TD (Type depository).

Also, the specimen depositories in this study were examined from the following institutes:

EIHU	Entomological Institute, Hokkaido University, Japan
ELKU	Entomological Laboratory Kyusyu University, Japan
HNUSEL	Systematic Entomology Laboratory, Hannam University, Korea
INU	Department of Life Sciences, Incheon National University, Korea
KNAE	Korea National Insect Collection, Korea National Arboretum, Korea

Systematic Accounts

Order Lepidoptera Linnaeus, 1758

Family Gracillariidae

Subfamily **Lithocolletinae** Stainton, 1854

Genus *Cameraria* Chapman, 1902

Cameraria Chapman, 1902: 141.

Type species: *Lithocolletis guttifinitella* Clemens, 1859

Diagnosis. The *Cameraria* Chapman, 1902 is distinguished from other genera of Lithocolletinae by the outer black edges

of white fascia on forewing and simple aedeagus with distinct broaden base.

Taxonomic Key to the Species of the Genus *Cameraria* in Korea

1. Second white fascia of forewing straight to dorsum
..... *Cameraria hikosanensis*
Second white fascia of forewing not straight to dorsum ...
..... 2
2. Dorsal stria near apical part curved and extend to apically;
9th sternite of male genitalia with highly bifurcated apical
part *C. nipponica*
Dorsal stria near apical part curved to apically and do not
extended; 9th sternite of male genitalia not bifurcated
apical part *C. acericola*

Cameraria acericola Kumata, 1963 털고로쇠가는나방 (신칭) (Fig. 1A, 2A)

Cameraria acericola Kumata, 1963: 33-35. TL: Hokkaidō, Japan. TD: EIHU (Holotype; Paratypes).

Adult (Fig. 1A). Wingspan 7.0 mm. Head pure white, smooth with a tuft of erected ochreous scales on occiput; frons and face pure white; labial palpus white and porrect; antenna slightly shorter than forewing, ochreous with fuscous spots on dorsally; scape whitish with a fuscous spot dorsally. Thorax mixed with ochreous, silvery gray and white; legs silvery gray and white with fuscous apical bands; fore coxa dark silvery gray; fore femur fuscous ventrally and whitish dorsally; fore tarsus white with two fuscous bands on first segments, one medially and the last one most broaden; middle and hind legs pure white with distinctive fuscous apical bands; hind tibia white with an ochreous broad band subapically, and a tuft of long bristles along laterally.

Forewing ground color ochreous with white costal and dorsal fascia, edged blackish lines posteriorly; a median basal streak white, as long as 1/9 of forewing; a costal white spots on 1/3 to base as opposite dorsal fascia; first dorsal fascia longitudinally extend to 1/4 of forewing from dorsum to costal and curved to outward; a median costal fascia extend to 1/3 of

forewing from costal, curved to outward and meet with second dorsal fascia; apical costal fascia at 3/4 to base, highly curved to outward and meet with third dorsal fascia at middle; an apical stria meet with apical costal fascia and third dorsal fascia at one point, and also blackish dorsal stria; cilia long and pale ochreous with a black line on tornus.

Male genitalia (Fig. 2A). Tegumen short, reduced and slightly curled; subscaphium with many of tiny spinules. Valva narrow and slender at base to nearly median part, dilated to apically and apical part fist-shaped; long and slender setae densely apically except for median to base, and 3-5 of short and stout setae on basal costal part. Vinculum elongated and narrow without saccus. Aedeagus bar-shaped and narrowed to apically with broaden and membranous base.

Female genitalia. Unknown.

Material examined. [GG] 1♂, Korea National Arboretum, Gwangneung, 14 vi 2018 (leg. BS Park, YM Shin, SW Jo, W Ki), gen. slide no. HNUSEL-5650-coll. KNAE; [JB] 1♂, Jangsu-gun, Beonam-myeon, Saam-ri, Banghwadong recreational forest, 24 v 2012 (leg. NH Ahn, JJ Park), gen. slide no.

HNUSEL-5656-coll. HNUSEL.

Distribution. Korea (new record), Japan, Russia.

Host plants. *Carpinus cordata* Blume [Betulaceae] in Korea (in this study). *Acer pictum* Thunb. ex Murray [Sapindaceae] in Japan (Kumata, 1963; De Prins and De Prins, 2006-2021). *A. pseudosieboldianum* (Pax) Kom. [Sapindaceae] in Russia (Ermolaev, 1977; De Prins and De Prins, 2006-2021).

Remarks. This species reared from *Carpinus cordata* Blume of the family Betulaceae in this study.

Cameraria hikosanensis Kumata, 1963 달팽나무가는 나방 (신칭) (Fig. 1B, 2B)

Cameraria hikosanensis Kumata, 1963: 43-45. TL: Kyūshū, Japan. TD: ELKU (Holotype); ELKU, EIHU (Paratypes).

Adult (Fig. 1B). Wingspan 6.0 mm. Head smooth with silvery white and ochreous scales; occiput with erected ochreous scales; frons and face pure white; maxillary palpus very small and reduced; labial palpus white; antenna silvery pale ochreous

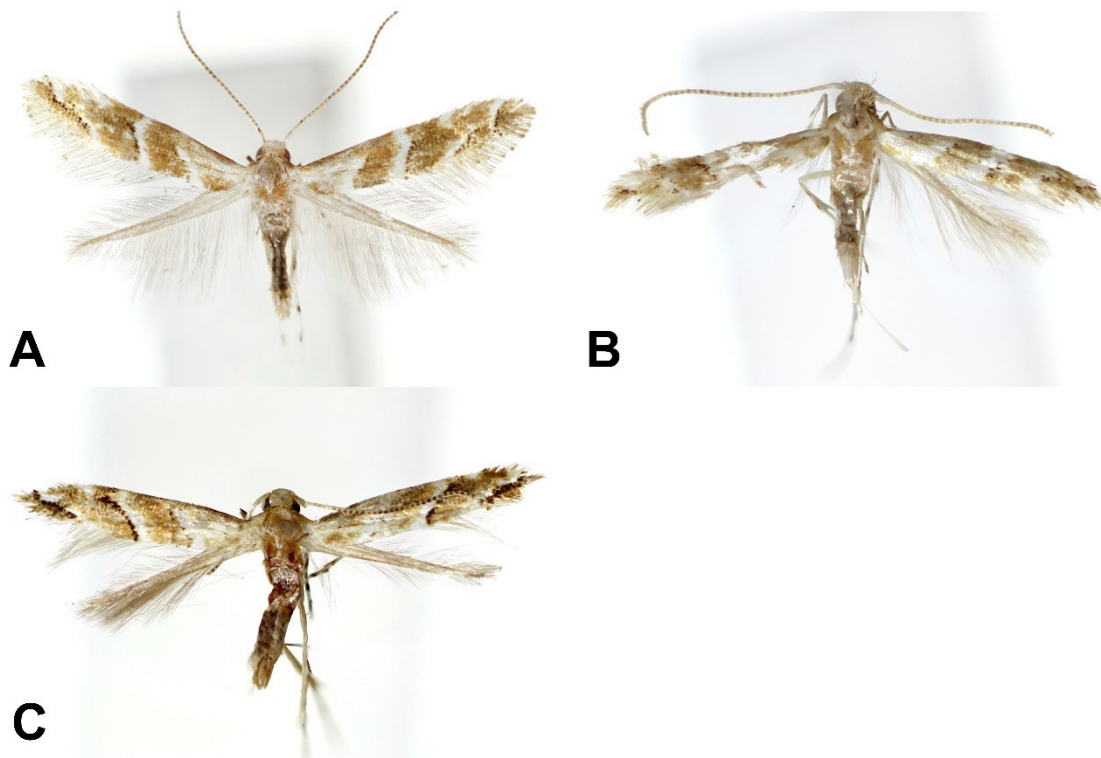


Fig. 1. A-C. Adults of the genus *Cameraria*. A, *Cameraria acericola*, (gen. slide no. HNUSEL-5656); B, *C. hikosanensis* (gen. slide no. HNUSEL-5622); C, *C. nipponica*, (gen. slide no. HNUSEL-5644).

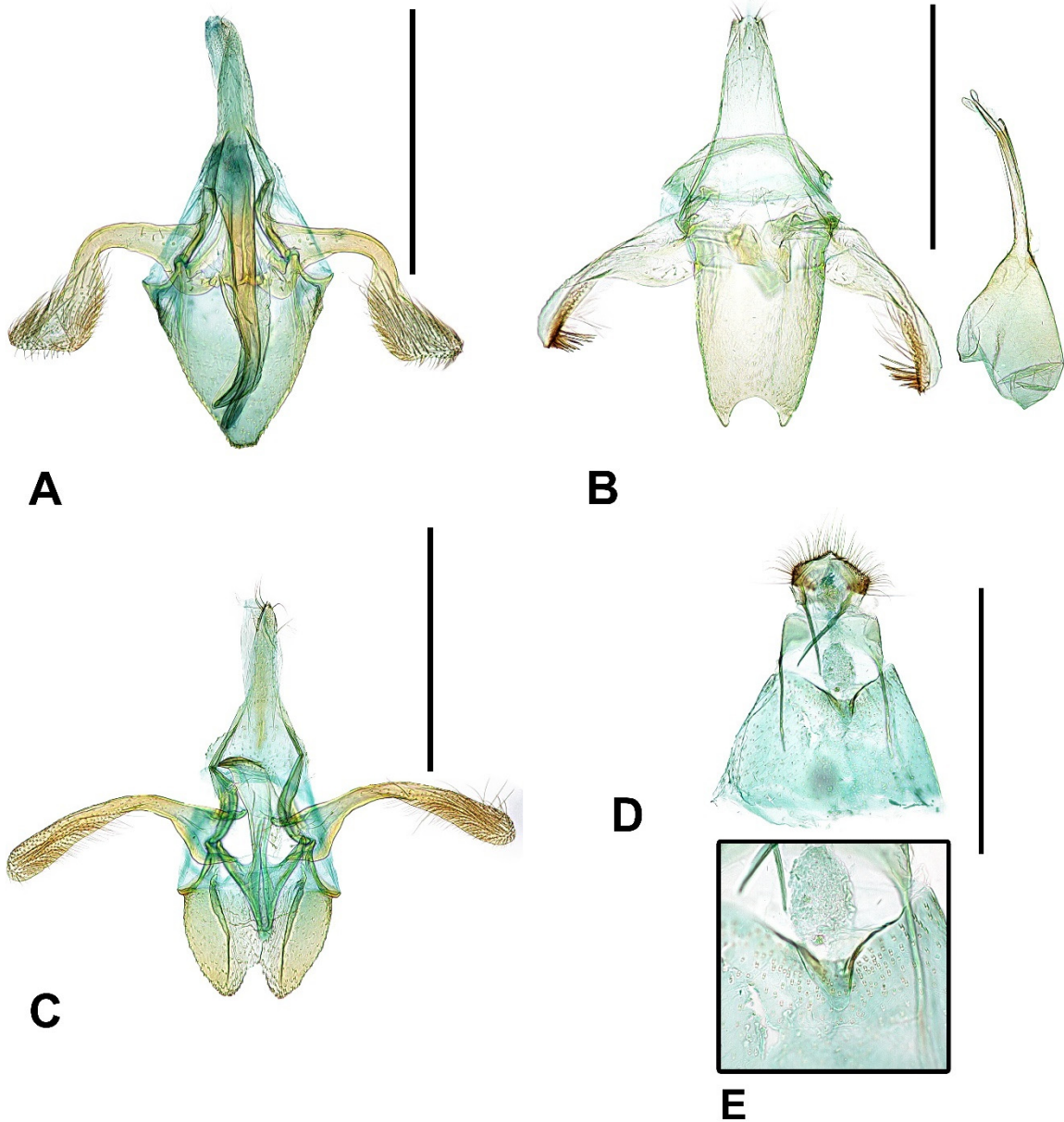


Fig. 2. A-E. Genitalia of the genus *Cameraria*. A, *Cameraria acericola*, male, (gen. slide no. HNUSEL-5656); B, *C. hikosanensis* male, (gen. slide no. HNUSEL-5622); C, *C. nipponica*, male, (gen. slide no. HNUSEL-5644); D, *C. nipponica*, female, (gen. slide no. HNUSEL-5637); E, ditto, ostium bursae. <scale bars: 0.5 mm>.

dorsally and silvery white ventrally; scape of antenna white. Thorax silvery gray on middle, fuscous at base and whitish laterally; legs white with fuscous bands.

Forewing ground color ochreous with white fasciae; a median basal streak extend 1/6 to base and slightly oblique to costa; first white fascia at 1/3 to base, slightly oblique to outward and shortly narrowed at 1/3 to dorsum; second white fascia at a half of forewing slightly oblique to outward, more

straight than first one and an outer blackish edge disappearing at middle; an apical costal stria at 3/4 to base without black edges; a dorsal fascia curved to apically; two short white stria at apex.

Male genitalia (Fig. 2B). Tegumen as long as 9th sternite and narrowed to apically with two pair of slender setae. Valva arm-shaped with biceps, swollen at base to median part and rapidly narrowed apically; short and slender setae near base sparsely and strong and long setae apically. Vinculum and

saccus somewhat reduced. Aedeagus bar-shaped with largely broaden to ovate and narrowed apically. 9th sternite flap-like with bifurcated apical part.

Female genitalia. Unknown.

Material examined. [CN] 1♂, Anmyeondo-Natural Recreation Forest, near, Seungeon-ri, Anmyeon-eup, Taean-gun, 26 viii 2015 (leg. Park, Shin, Kim, Nam), gen. slide no. HNUSEL-5622-coll. KNAE.

Distribution. Korea (new record), Japan.

Host plants. *Viburnum erosum* Thunb., *V. sieboldi* Miq. [Caprifoliaceae] (Kumata, 1963; De Prins and De Prins, 2006-2021).

Cameraria niphonica Kumata, 1963 청시닥가는나방 (신칭) (Fig. 1C, 2C, 2D–E)

Cameraria niphonica Kumata, 1963: 35-37. TL: Kyūshū, Japan. TD: ELKU (Holotype); EIHU (Paratypes).

Adult (Fig. 1C). Wingspan 6.5 mm. Head white; maxillary palpus white, minute and somewhat reduced; labial palpus with rough scale of fuscous and white; antenna white except for grayish dorsal side; scape white with a tuft of fuscous scales on below. Thorax fuscous and white; legs white and fuscous; fore femur and tibia white with fuscous ventral part; tarsus white with apical fuscous bands.

Forewing ground color goldish orange ochreous with white fasciae; a narrow median basal white streak as long as vertical length of forewing at base; first white fascia at 1/4 to base, bent near costal margin and forming acute angle to outward; second fascia on middle of forewing and more bent than first one; a short white costal stria on 2/3 to base; a white dorsal stria curved rectangularly, reached to outward and extend to apex.

Male genitalia (Fig. 2C). Tegumen elongated and narrowed to apex with long setae. Valva narrow and slender, 1.3 times longer than tegumen, slightly drooped and apex rounded; long and slender setae on median to apex not much densely. Vinculum triangular without saccus. Aedeagus bar-shaped and sclerotized to apex with membranous and enlarged base. 9th sternite short and reduced with highly bifurcated apical part.

Female genitalia (Fig. 2D-E). Papillae anales sclerotized and apex somewhat acute with long and slender caudal setae;

apophyses anteriores 1.2 times longer than apophyses posteriores. Ostium bursae large in opening size with slightly sclerotized antrum. Ductus bursae long and slender. Corpus bursae with a sclerotized plate and cone-shaped projection in center.

Material examined. [JN] 2♂, Mt. Baegun, Gwangyang-si, 12 vii 2012 (leg. BK Byun), gen. slide no. HNUSEL-5643, 5644-coll. HNU; [GB] 1♀, Mt. Tonggosan, Geumgangsomyeon, Uljin-gun, 23 vi 2017 (leg. BS Park, SM Na, DJ Lee), gen. slide no. HNUSEL-5637-coll. INU.

Distribution. Korea (new record), Japan, Russia.

Host plants. *Acer japonicum* Thunb., *A. palmatum* Thunb. [Sapindaceae] in Japan (Kumata, 1963; De Prins and De Prins, 2006-2021). *A. barbinerve* Maxim., *A. caudatum* Wall., *A. pseudosieboldianum* (Pax) Kom. [Sapindaceae] in Russia (Ermolaev, 1979, 1988; Kirichenko et al., 2019; De Prins and De Prins, 2006-2021).

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Statements for Authorship Position & Contribution

Kim, D.S.: Basic Science Division, National Science Museum of Korea, Researcher; Experiment, Sample Identification, Conducted the experiments and wrote the manuscript

Ahn, N.H.: Genetic Resources Information Center, National

Institute of Biological Resources, Researcher;
Sample Identification

Byun, B.K.: Department of Biological Science and Biotechnology, Hannam University, Professor; Designed the research and Conducted the writing manuscript.

All authors read and approved the manuscript.

Literature Cited

- Byun, B.K., Park, K.T., Bae, Y.S., Lee, B.W., 2009. A checklist of the microlepidoptera in Korea (Lepidoptera). Korea National Arboretum, Pocheon.
- Chapman, T.A., 1902. The classification of *Gracilaria* [sic] and allied genera. The Entomol. 35, 81-164.
- Clemens, B., 1859. Contributions to American lepidopterology. Proc. Acad. Nat. Sci. 11, 256-262.
- De Prins, J., De Prins, W., 2006-2021. Global Taxonomic Database of Gracillariidae (Lepidoptera). World Wide Web electronic publication <http://www.gracillariidae.net> (accessed 5 February, 2022).
- Deschka, G., Dimic N. 1986. *Cameraira ohridella* sp. n. (Lep., Lithocolletidae) aus mazedonien, Jugoslawien. Acta Entomol. Jugoslavica 22, 11-23.
- Ermolaev, V.P., 1977. A review of the fauna and ecology of miner-moth (Lep., Gracillariidae) of the Primorye Territory. Pro. Zool. Inst. Acad. Sci. 70, 98-116.
- Ermolaev, V.P., 1979. On the study of mining moths, family Gracillariidae (Lepidoptera) from the south of the Far East, in: Ler, P.A. (Ed.), Terrestrial arthropods of the Far East. Akademija Nauk SSSR, Vladivostok, pp. 23-27.
- Ermolaev, V.P., 1988. Gracillariid moths of the genus Lithocolletis Hbn. (Lepidoptera, Gracillariidae) trophically associated with elm and maple in the south of the Far East. Entomol. (Entomological Review) 67, 346-359.
- Holloway, J.D., Bradley, J.D., Carger, D.J., 1987. CIE guides to insects of importance to man 1. Lepidoptera. CAB International, London.
- Kim, D.S., Byun, B.K., 2016. First discovery of winter-emerging leaf-miner: *Phyllonorycter styracis* (Kumata, 1963) (Lepidoptera: Gracillariidae) from Korea with DNA barcode. J. Asia-Pac. Biodivers. 9, 477-480.
- Kim, D.S., Byun, B.K., 2017. Taxonomic review of the genus *Phyllonorycter* Hübner (Lepidoptera: Gracillariidae) in Korea. J. Asia-Pac. Entomol. 20, 1377-1386.
- Kim, D.S., Byun, B.K., 2019. An annotated catalogue of the two genera *Liocrobyla* and *Spulerina* of the family Gracillariidae (Lepidoptera) from Korea with new records. J. Asia-Pac. Biodivers. 12, 444-447.
- Kim, D.S., Byun, B.K., 2022. Genus *Eteoryctis* Kumata & Kuroko, 1988 (Lepidoptera: Gracillariidae) in Korea with description of a new species. Zootaxa 5120, 402-408.
- Kirichenko, N., Augustin, S., Kenis, M., 2019. Invasive leafminers on woody plants: a global review of pathways, impact and management. J. Pest Sci. 92, 93-106.
- Kumata, T., 1963. Taxonomic studies of the Lithocolletinae of Japan (Lepidoptera: Gracillariidae) Part II. Insecta Matsumurana 26, 1-48.
- Lee, G.E., Jeun, Y.C., 2022. Eighteen species of microlepidoptera (Lepidoptera) new to Korea. J. Asia-Pac. Biodivers. 15, In Press. <https://doi.org/10.1016/j.japb.2022.01.005>
- Lee, S.H., Kim, D.S., Kim, I.K., Choi, C.W., Hwang, R.Y., Ku, D.S., Byun, B.K., 2017. Indigenous parasitoids as effective natural enemies of *Phyllocnistis citrella* (Lepidoptera: Gracillariidae) in Korea. J. For. Res. 28, 183-187.
- Linnaeus, C., 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Vol. 1 (10th ed.). Laurentius Salvius, Stockholm.
- Shin, Y.M., Lee, B.W., Byun, B.K., 2015. Taxonomic review of the Genus *Caloptilia* Hübner (Lepidoptera: Gracillariidae) in Korea. J. Asia-Pac. Entomol. 18, 83-92.
- Stainton, H.T., 1854. Lepidoptera: Tineina. in: Stainton, H.T. (Ed.), Insecta Britannica. Vol. 3. Lovell Reeve, London.