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Chrysaster ostensackenella (Fitch, 1859) (Lepidoptera: Gracillariidae) New to Korea

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국내 미기록종, 아까시나무가는나방, *Chrysaster ostensackenella* (나비목: 가는나방과)

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ABSTRACT: The genus *Chrysaster* Kumata is one of the members in Lithocolletinae of Gracillariidae (Lepidoptera: Gracillarioidea). *Chrysaster hagicola* Kumata, 1961 has been the only known species of the genus in Korea so far. In this study, we report another species, *Chrysaster ostensackenella* (Fitch, 1859) for the first time from Korea. The samples of *C. ostensackenella* were collected as larvae and adults on *Robinia pseudoacacia* L. (Fabales: Fabaceae). Diagnostic characteristics with a brief description are given, as well as, photographs of adults and genitalia of both sexes are provided. A further study on *C. ostensackenella* is strongly recommended, especially for the business of honey, as this species is recently known to be a serious pest on acacias (black locust) in China.

Key words: Gracillariidae, Lithocolletinae, *Chrysaster ostensackenella*, Korean fauna

초 록: *Chrysaster* Kumata, 1961는 Gracillariidae (나비목: 가는나방상과)의 Lithocolletinae에 속해 있으며 우리나라에는 *Chrysaster hagicola* Kumata, 1961 한 종만이 알려져 있다. 본 연구에서는 동속의 국내 미기록종인 *Chrtsaster ostensackenella* (Fitch, 1859)를 처음으로 소개한다. 본 종의 유충과 성충은 *Robinia pseudoacacia* L. (콩목: 콩과)에서 채집되었다. 종 동정을 위한 특징과 간략한 기재를 제시하고, 성충과 수컷 및 암컷 생식기의 사진을 제공하였다. 최근 중국에서 양봉업에 매우 중요한 아까시나무의 심각한 해충으로 보고된 바 있어 본 종에 대해 조속한 추가 연구가 필요한 상황이다.

검색어: 가는나방과, 가는나방아과, 아까시나무가는나방, 한국동물상

Gracillariidae, one of the important and huge groups of microlepidoptera, include about 2,000 species in the world, and most of them are leaf miners at larval stage (De Prins and De Prins, 2006-2018). There are three subfamilies belonging to Gracillariidae and they show distinction in the resting posture at adult stage: most genera of Gracillariinae pose with forepart of body raised steeply while those of Lithocollectinae and Phyllocnistinae pose body parallel to the surface, but some of Lithocollectinae rest with head lowered (Davis and Robinson, 1999). In Lithocollectinae, 10 genera and 508 species, including *Chrysaster* Kumata, 1961, and 870 species of host plants have been reported (De Prins and De Prins, 2006-2018).

In the genus *Chrysaster*, only two species had been known: *C. ostensackenella* (Fitch, 1859), from North America, and *C. hagicola* Kumata, 1961, from East Asia including Korea. Recently, both species were reported from China (Bai et al., 2015; Liu et al., 2015), which is surprising as *C. ostensackenella*

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is a New World species that had never been reported from the Old World. While *C. ostensackenella* and *C. hagicola* are known to feed on some species of *Robinia* (Fabales: Fabaceae) and *Lespedeza* (Fabales: Fabaceae), respectively, Liu et al. (2015) also added *Campylotropis macrocarpa* (Fabales: Fabaceae) as a host plant of *C. hagicola*.

Here we report that, in addition to *C. hagicola*, *C. ostensackenella* is now found in Korea as well. Diagnostic characteristics and a brief description of *C. ostensackenella*, photographs of the larva and its mine, adult, and genitalia of both sexes are given. In addition, COI barcode sequences of both species are also provided for further molecular phylogenetic studies.

Materials and Methods

Larvae and adults of *C. ostensackenella* were collected from black locust trees, *R. pseudoacacia* in the day time and at night using UV black light. For laboratory rearing, each larva was kept in a Petri dish (Ø55 mm × 15 mm) with a leaf of a host species, *R. pseudoacacia*, until emergence.

Genitalia were dissected in a series of ethanol (from 50% to over 95%), stained with chlorazol black and mercurochrome, and slide-mounted in Euparal.

To obtain its COI barcode sequences, genomic DNA was extracted using the Genomic DNA Prep kit (SolGent Co., Ltd., Korea) and PCR amplification was conducted using 2X h-Taq PCR Pre-Mix (SolGent Co., Ltd., Korea). The primer set (LCO-1490 and HCO-2198) followed Folmer et al. (1994), with 35 cycles (95℃ 30 s, 50℃ for 40 s, and 72℃ for 45 s). For each PCR amplification condition, pre-denaturation step at 95℃ for 15 min before the 1st cycle and final polymerization step at 72℃ for 5 min right after the 35th cycle were added. The PCR product was purified using QIAquick Gel Extraction Kit (Qiagen, Hilden, Germany). The COI barcode sequences obtained were confirmed its specific identity by comparing sequences of the same species on NCBI (https://www.ncbi.nlm.nih.gov).

Abbreviations of the provinces in Korea used for the collected material are as follows: GG, Gyeonggi province; CB, Chungbuk province; JN, Jeonnam province.

Systematic accounts

Genus *Chrysaster* Kumata, 1961

Chrysaster Kumata, 1961. Ins. Matsum. 24 (1): 52-56. Type species: *Chrysaster hagicola* Kumata, 1961. Type locality: Hokkaido, Japan.

***Chrysaster ostensackenella* (Fitch, 1859) 아까시나무가는나방 (신칭)** (Figs. 1, 2)

Argyromiges ostensackenella Fitch, 1859. Rept. Ins. N. Y., v, 338. TL: New York, U.S.A.

Lithocolletis ornatella Chambers, 1871. Can. Ent., iii, 161-163.

Lithocolletis ostensackenella Chambers, 1871. Can. Ent., iii, 183.

Diagnosis. This species can be easily distinguished from *C. hagicola* by the following characteristics: tuft on head, blackish, not gold ocherous; saccus distally widened, truncated, and slightly concave (Kumata et al., 1983); and a short, silvery-white, median longitudinal streak near base of forewing absent (Kumata, 1961). In *C. hagicola*, head tuft is gold ocherous, distal end of saccus is not as much widened as in *C. ostensackenella*, rather slightly convex, and a short, silver-white, median longitudinal streak near base of forewing is usually present.

Head. Head with short blackish tuft; antenna dark brown, as long as forewing.

Thorax. Wingspan 4-6 mm (n = 20). Thorax covered with metallic gold-brown scales. Forewing ground color orange, shiny, slightly darker basally, silvery white basally; four transverse fasciae silvery white outwardly, black inwardly; post-median and sub-terminal fasciae broken near middle. Termen black.

Abdomen. Abdomen metallic, dark brownish grey (Fig. 1B).

Male genitalia (Fig. 1B and C). Ventro-distal projection of valva pointed more ventrally than distally, only slightly longer than the mid-distal projection of valva. Aedeagus near straight, not angled around middle. See Kumata et al. (1983) and Liu et al. (2015) for detailed characteristics distinguishing between *C. ostensackenella* and *C. hagicola*.

Female genitalia (Fig. 1D). Corpus bursae membranous without signum. Ductus bursae very short with a sclerotized antrum. Anterior and posterior apophyses similar in length. No

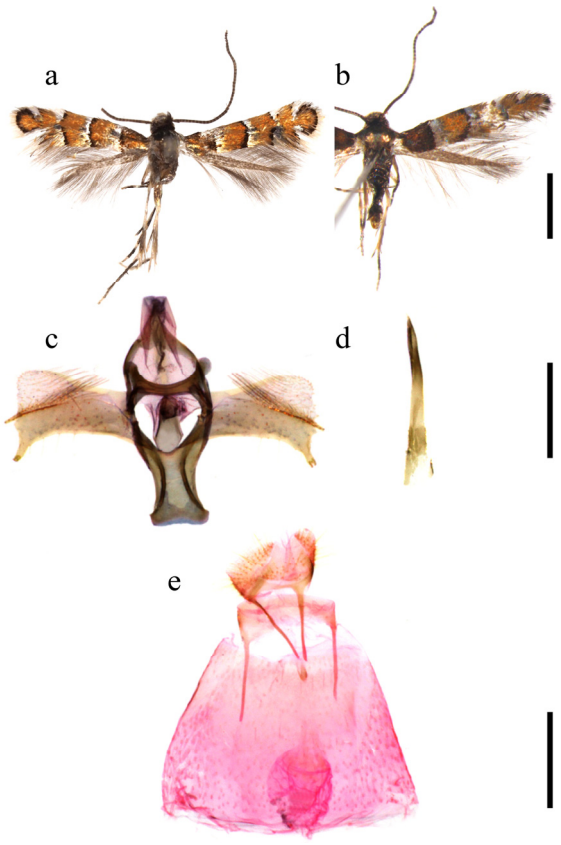

Fig. 1. *Chrysaster ostensackenella* (Fitch, 1859). a, b, adult; c, male genitalia; d, aedeagus; e, female genitalia. Scale bars: a = 1 mm, b-d = 0.2 mm.

prominent characters to distinguish the two species. See Liu et al. (2015).

Material examined. Adults: 9 ♂, 11 ♀, Chungbuk Univ., Gaesin-dong, Cheongju-si, CB, Korea, N36°37'43.39" E127° 27'02.71", Alt. 67 m, 29 vi 2017 (SK Kim & JM Koo), gen. slide no. KJM0017 (♂), KJM0096 (♂), KJM0097 (♀), KJM0098 (♀); 5 larvae, Bundang-gu, Seongnam-si, GG, Korea, N37°23'33.76" E127°05'30.63", Alt. 93 m, 13 vii 2017 (JM Koo and HE Lee); 4 larvae, Singi-dong, Yeosu-si, JN, Korea, N34°45'23.30" E127°40'43.45", Alt. 86 m, 7 vii 2017 (HE Lee); 7 larvae, Seongbuk-gu, Seoul, Korea, N37°35'08.79" E127°01'37.91", Alt. 45 m, 27 vii 2017 (JM Koo).

Host plant. Fabaceae: *Robinia hispida, R. pseudoacacia, R. neomexicana, R. viscosa* (Chambers, 1871, 1878; Braun, 1935; Liu et al., 2015).

Distribution. Korea (new record), China, Canada and U.S.A.

COI barcode sequence. We obtained COI barcode sequences from seven specimens and they were all 99% identical to the sequence (KX069358.1) of *C. ostensackenella* in NCBI. The COI barcode sequences of *C. ostensackenella* and *C. hagicola* showed 91-92% similarity in p-distance while the sequence similarity within-species showed 99-100%. P-distance of 8-9% is a considerable difference for a specific distinction. In addition, we sequenced the COI barcodes from two larval specimens of *C. hagicola*. Two representative sequences for each species are as follows:

C. ostensackenella

AACATTATATTTTATTTTTGGAATCTGATCAGGAATAGT
AGGATCCTCTTTAAGAATTTTAATTCGTGTTGAATTAGG
AACTCCAGGATCAGTAATTGGAGATGATCAAATTTATA
ATACTATTGTAACAGCTCATGCATTTATTATAATTTTTT
TTATAGTTATACCTATTATAATTGGGGGATTTGGTAATT
GATTAGTACCATTAATATTAGGTGCCCCAGATATAGCC
TTTCCCCGTCTTAATAATATAAGATTCTGACTACTTCCC
CCTTCTATTTTATTATTAATTTCCAGAAGAATTGTAGAA
AGAGGAGCGGGAACTGGGTGAACTGTTTATCCCCCCCT
ATCATCTAATATTGCTCATAGAGGAAGATCAGTAGATT
TAGCCATTTTCTCCTTACATTTAGCAGGAATTTCATCTA
TTTTAGGAGCTATTAATTTTATTACAACTATTATTAATA
TACGAGCTAATGGGATAATATTTGATAAAATACCTTTA
TTTGTCTGAGCAGTTGGTATTACTGCATTATTATTACTT
TTATCCCTACCTGTATTAGCAGGAGCTATTACAATATTA
TTAACAGATCGAAATATTAATACTTCTTTTTTTGATCCA
GCTGGAGGAGGAGATCCTATTTTATATCAACATTTATTT

C. hagicola

AACATTATATTTTATTTTTGGAATTTGATCAGGAATAGT
AGGAACTTCTTTAAGAATCTTAATTCGTGTTGAATTAGG
AACCCCGGGTTCAATAATCGGAAATGATCAAATTTATA
ATACTATTGTCACAGCTCATGCATTTATTATAATTTTTTT
TATAGTTATACCTATTATAATTGGAGGATTCGGTAACTG
ATTAGTTCCACTAATATTAGGGGCTCCAGATATAGCTTT
CCCCCGCCTTAATAATATAAGATTTTGATTATTACCCCC
TTCTATTTTATTATTAATTTCTAGAAGAATTGTAGAAAC
AGGAGCAGGAACTGGATGAACTGTTTATCCTCCATTAT
CATCTAATATTGCTCATAGAGGAAGATCAGTAGACTTA
GCTATCTTTTCATTACATTTAGCAGGAATTTCATCTATT
TTAGGGGCAATTAATTTTATCACAACTATTATTAATATA
CGAACTAACGGAATATTATTTGACAAAATACCATTATT
TGTTTGAGCAGTAGGAATTACTGCATTATTATTACTCTT

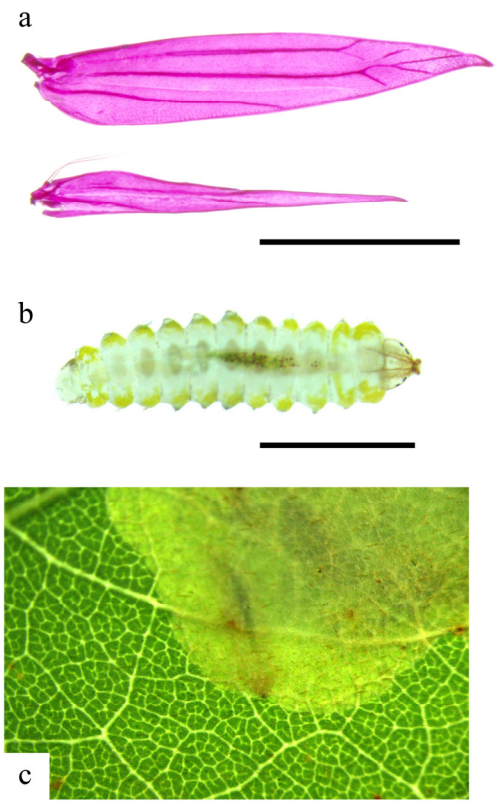

Fig. 2. *C. ostensackenella.* a, wing; b, larva; c, larva inside the mine. Scale bar: a, b = 1 mm.

ATCGTTACCTGTATTAGCGGGAGCTATTACAATATTATT
AACAGATCGAAATCTTAATACTTCTTTTTTTGACCCGGC
TGGAGGAGGAGATCCTATTTTATATCAACATTTATTC

Remarks. The larvae mine leaves of black locust and chew mesophyll of it (Fig. 2B and C; https://www.youtube.com/watch?v=qqNLoy0cX7E&feature=youtu.be). On the upper side of the leaf, the mine looks like a circular yellowish blotch in early stage, and over time, it becomes irregular in shape. Sometimes, it occurs underside of the leaf. Pupation occurs inside the leaf mine (Braun, 1908) or outside the mine. In China, *C. ostensackenella* has four generations a year (Liu et al., 2015).

Discussion

Finding of *C. ostensackenella* in Korea means it is probably introduced from China. As they feed on false acacia, bee or honey business may be affected depending on how serious the damage is to the trees. In case of China, Liu et al. (2015) noted that, when infested, more than 80%, over 90% when seriously infested, of the leaflets of black locust trees were attacked and damaged in Yantai, Shandong Province, and emphasized that relevant control measures should be undertaken and intensive studies should be conducted to fully understand this invasive species.

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