

기주식물을 포함한 한국산 얼룩애기물명나방, *Elophila turbata* (나비목, 포충나방과, 물명나방아과)에 대하여

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An Aquatic Moths, *Elophila turbata* (Butler, 1881) (Lepidoptera, Crambidae, Nymphulinae) in Korea, with New Host Plants

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ABSTRACT : Morphological characters of adult and immature stages on *Elophila turbata* (Butler, 1881) belonging to subfamily Nymphulinae, family Crambidae are redescribed base on Korean materials. Also we observed biological characters of this species including host plants, *Spirodela polyrhiza* (L.) Schleiden, *Salvinia natans* (Linné) Allioni and *Lemna perpusilla* Torre. And, photographs of adult, genitalia and immature stages are provided.

KEY WORDS : *Elophila turbata*, Nymphulinae, Crambidae, *Spirodela*, *Salvinia*, *Lemna*, Immature stages, Korea

초 록 : 포충나방과의 물명나방아과에 속하는 얼룩애기물명나방(*Elophila turbata* (Butler, 1881))에 대한 성충, 종령유충, 번데기의 형태적 특징과 암수생식기를 도해하여 재기재하였으며, 또한 이 종의 생태적 특징을 관찰하고, 기주식물로 개구리밥, 좁개구리밥(*Lemna perpusilla*), 생이가래(*Salvinia natans*)를 확인하였다.

검색어 : 얼룩애기물명나방, 포충나방과, 물명나방아과, 좁개구리밥, 생이가래, 개구리밥, 유충, 한국

Introduction

The subfamily Nymphulinae is mainly distributed throughout the Neotropical and Oriental regions with 716 described species (Heppner, 1991). Most of larvae belong to this subfamily are aquatic, often breathing by means of gills and feedings on aquatic plants. Adults females

dive underwater to lay eggs.

Since Butler (1881) was described on *Elophila turbata* as *Paraponyx turbata* from Yokohama, Japan. Yoshiyasu (1985) described on biology, larval chaetotaxy, and pupal morphology from Japan. Park (1983) reviewed 12 species including *Elophila turbata* (Butler) of 6 genera belonging to the this subfamily in Korea. *Elophila turbata* (Butler)

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is a common species of this subfamily in Korean peninsula, but the morphological and biological study of this species have been insufficiently remained until now because of its small size and difficulties of collecting and rearing.

We collected larvae and pupae of this species on *Spirodela polyrhiza* (Linné) Schleiden, new host plants *Salvinia natans* (Linné) Allioni and *Lemna perpusilla* Torre in Korea. In the present study, we are redescribed with morphology of adult and immature stages on *Elophila turbata* (Butler, 1881) and with its habitat and biology base on Korean materials for the first time. And photographs of adult, genitalia, and immature stages are provided.

Materials and Methods

A total of 338 adult specimens (175 exs. males and 163 exs. females) are examined in this study. Four pupae and five larvae were collected on three host plants in Upo-swamp, Changnyong. The pupae were reared in transparent plastic breeding cases (14 cm × 14 cm × 7 cm) on the water in the laboratory under controlled conditions (about 25°C).

Taxonomy and Biology

Elophila turbata (Butler, 1881) 얼룩애기물명나방 (Figs. 1-6)

Parapopynx turbata Butler, 1881, Trans Ent. Soc. 1881 (4): 586 (Type-locality: Yokohama, Japan); Pryer, 1885: 61.

Nymphula responsalis Walker, 1865, List Specimens lepid. Insects Colln Br. Mus. 34: 1326; Hampson, 1896: 192; Tams, 1924: 284; Inoue, 1982, I: 370, II: 242, pl. 55, fig. 23; Park, 1994: 336.

Nymphula turbata: Meyrick, 1894: 10, 470; Leech, 1901: 433; Shibuya, 1928: 141, 143; Ins. Mat., 1931: 1044; Tsuda, 1936: 1572; Inoue, 1954, 155; Mutuura, 1957: 118, pl. 20, fig. 622; Inoue, 1959: 244; Zool. Soc. Kor.,

1968: 50; Park, 1980: 184; Inoue, 1982: 2: 242; Park, 1983: 388, pl. 26. fig. 417; Esaki, 1984: 118, pl. 20, fig. 622.

Leparides floralis Leech, 1889, Entomologist 22: 71, pl. 4. fig. 1; Park, 1976: 18.

Hydrocampa sultschana Ragonot, 1893. in Romanoff, Mém. Lépid. 7: 174.

Parthenodes sultschana Hampson, 1900, Trans. ent. Soc. Lond. 1900: 384.

Elophila turbata: Speidel, 1984: 58; Check list. Ins. Jap. (II). 1989: 958.

Elophila (Cytogramme) turbata: Yoshiyasu, 1985: 27.

Adult (Fig. 1, A-C). Wingspan 6-7 mm in male, 9.0 mm in female. Head pale brown. Frons ochreous, suffused with pale brown scales on mid dorsal area. Vertex with tuft, pale ochreous scales. Antenna about 2/5 as long as forewing length, ciliate, with scape ochreous, brownish at base; flagellum having a series of sparse and fulvous scales dorsally. Ocellus well-developed, dark brown. Labial palpus ascending, with basal 2 segments whitish mixed with brown inner side milky white, outside pale brown; the 3rd segment small, conical, basal half hidden by scales of basal 2 segments. Maxillary palpus milky white, outside fuscous. Proboscis with whitish scales at base. Patagium milky white suffused pale brown, tegula whitish, with two fuscous oblate patches at anterior and median areas thorax pale ochreous. Foreleg and midleg whitish; hindleg whitish, inner tibial spur almost as long as outer one; tarsus fulvous. Abdomen with fuscous area at anterior portion, whitish at posterior portion of each segment.

Forewing (Figs. 1-A, B, C, 3). Apex broadly rounded; termen a little expanded from middle of wing; tornus rounded. Vein Sc rather short, ending at costa near distal margin of cell; R₂ stalked with R₃₊₄ at base; R₅ and M₁ straight; CuP absent.

Hindwing (Figs. 1-B, C, 3). Apex rounded; termen weakly incised behind apex. Sc+R₁ stalked with Rs near basal half.

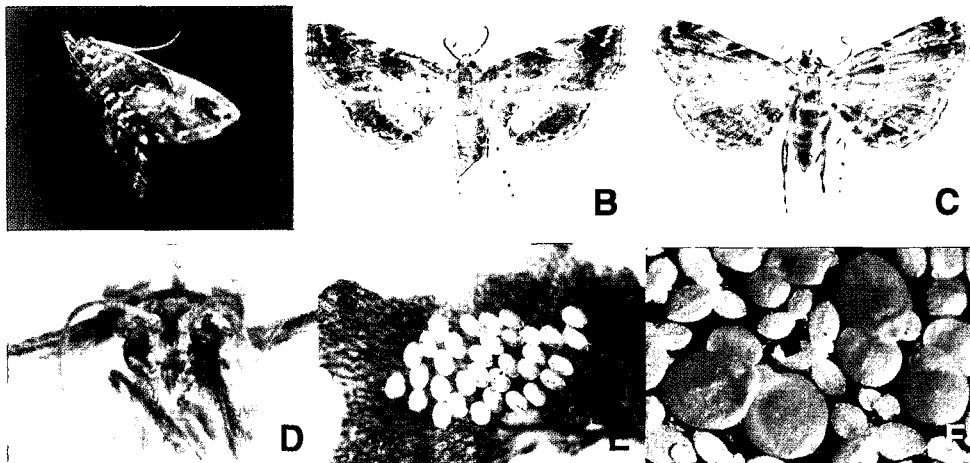


Fig. 1. *Elophila turbata* (Butler). A, B, adult (♀); C, adult (♂); D, head, frontal view; E, eggs; F, host-plants, *Spirodela polyrhiza* (Linné) Schleiden and *Lemna perpusilla* Torre.

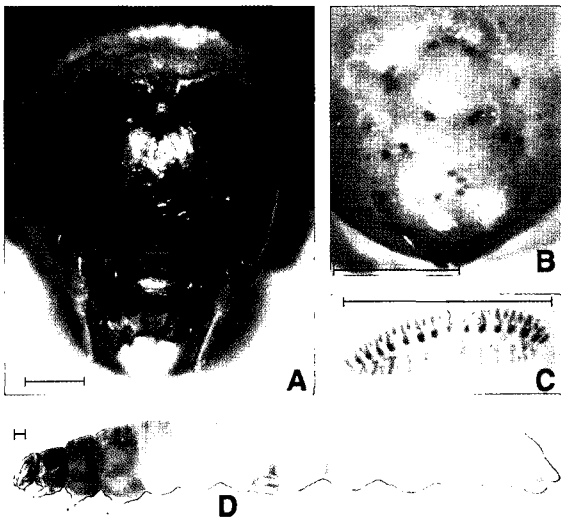


Fig. 2. Larva of *Elophila turbata* (Butler). A, head, frontal view; B, 10th abdominal segment, dorsal view; C, 4th left proleg with crochets; D, whole larva. Scale bar = 0.5 mm.

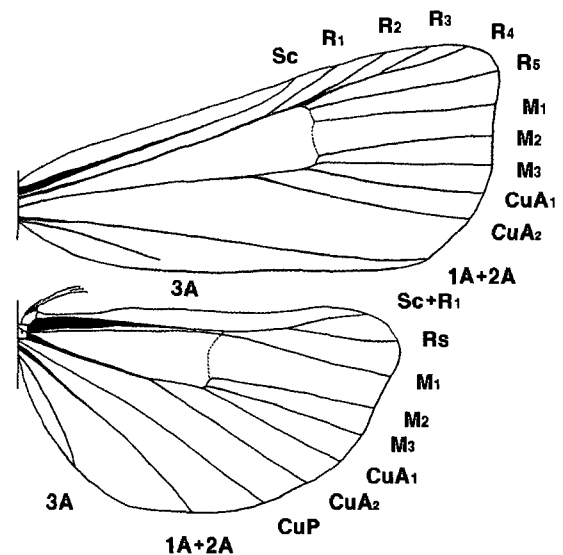


Fig. 3. Wing venation of *Elophila turbata* (Butler).

Male genitalia (Fig. 4). Tegumen wide, anterior margin with well-developed ridge. Vinculum almost as long as tegumen. Saccus small. Fenestrula triangular at uncus base in dorsal view. Uncus weakly sclerotized, tapered at apex. Gnathos short, triangular at apex, widened at base, with 4 or 5 dorsal spines. Valva rather short, apical margin broadly rounded; costa short, with indistinct vertical wrinkles; ampulla with 2 or 3 flat and long setae; inner surface of ampulla with numerous setae. Phallus short; vesica with cornuti. Juxta rectangular, bifurcated at apex.

Female genitalia (Fig. 5). Papila analis with long setae. Apophysis posterioris very long, 1.2 times as long as anterioris. Apophysis anterioris long and slender. Ostium bursae rather wide. Ductus bursae long, equal to 7th sternum. Bursal ring very wide, weakly sclerotized, with indistinct acute projections mid-dorsally. Corpus bursae small without signum.

Mature larva (Fig. 2). Head width 1.6 mm, body length, 18-21 mm. Head evenly metallic blackish; ocelli area whitish. Thorax grayish white. Prothorax with well-

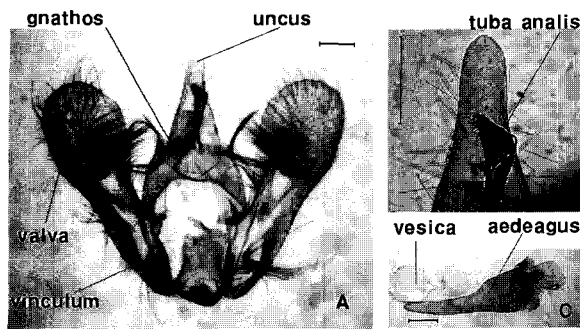


Fig. 4. Male genitalia of *Elophila turbata* (Butler). A, whole genitalia (dorsal view); B, uncus; C, phallus. Scale bar = 0.1 mm.

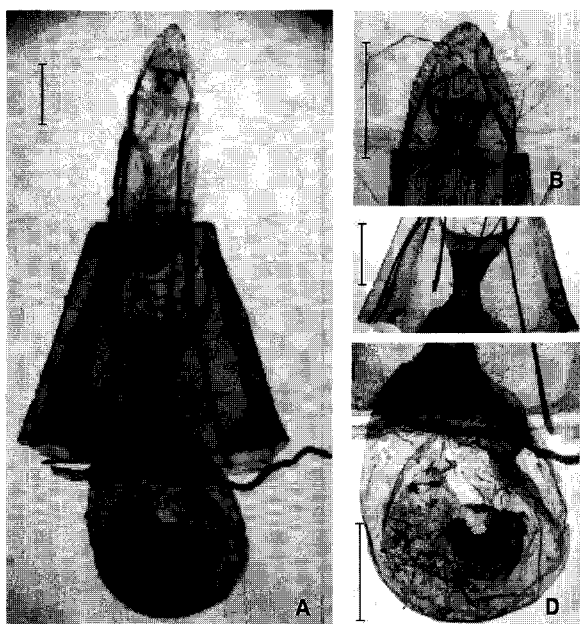


Fig. 5. Female genitalia of *Elophila turbata* (Butler). A, whole genitalia (ventral view); B, 9th sternum; C, 8th sternum; D, Corpus bursa. Scale bar = 0.5 mm.

developed prothoracic plate, evenly metallic blackish; prothoracic legs with coxae on both sides fused at mid-ventral line. Meso- and metathoracic legs with coxae of both sides separated at base. Abdomen much broader than thorax, milky white. Anterior portions of 1st to 8th segments expanded dorsally. Prolegs weakly expanded; crochets almost transversely arranged and anterior series of crochets slightly longer, biordinal and about 25 in total number.

Pupa (Fig. 6). Body length 7.0 - 11.5 mm, width 2.0 - 3.0 mm. Body pale brown or brown. Head with frons

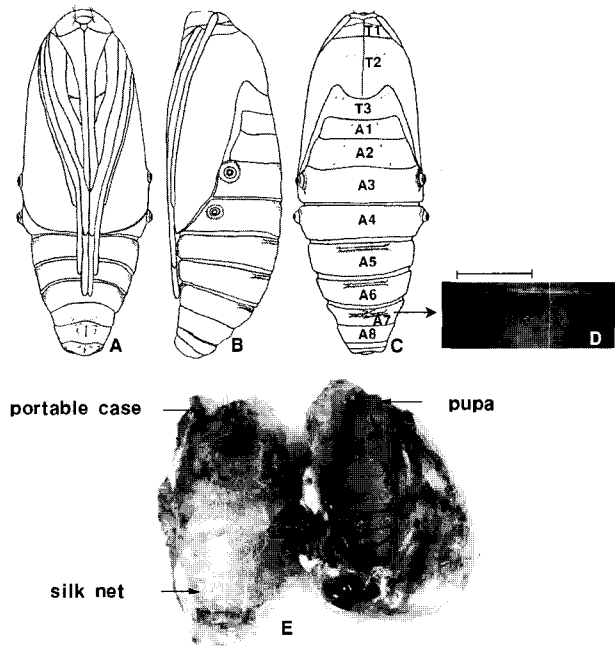


Fig. 6. Male pupa of *Elophila turbata* (Butler). A, ventral view; B, *ditto*, lateral view; C, *ditto*, dorsal view; D, 7th abdominal segment with characteristic crevice; E, pupa in larval case. Scale bar = 1.0 mm.

rather flat in dorsal view. Maxilla short, beyond the wing length; antenna not extending to apex of wings. Wing extending to 4th abdominal segment. Trochanter of foreleg ending a little beyond apex of metathorax; midleg long, far beyond apex of 6th abdomen; hindleg longer than the midleg. Abdomen rather stout; spiracles on 3rd and 4th segments well-developed, protruded at bases; posterior half of 4th to 6th segments with granulate punctures; dorsal surfaces of 5th to 7th segments with characteristic crevices of which anterior and posterior edges dentate with many minute setae; posterior margin of 10th segment broadly rounded without special setae.

Material examined. [GW] 1 ♀, Mt. Seolak, Hange-ri, 9. IX. 1993 (S.B. Ahn); 1 ♀, Chuncheon, 26. VII. 1974 (Y.I. Lee); 1 ♀, Yupo-ri, Sinbuk-eub, Chuncheon, 16. IX. 2006, 1 ♀, 30. VII. 2006, 1 ♀, 2. VIII. 2006 (J.H. Jin); 1 ♀, Hongcheon, 15. VI. 1989 (K.S. Lee); 1 ♀, Waya-ri, Naechon, Hongcheon, 3. VIII. 2006, 1 ♀, Mt. Yeonyeob, Hongcheon, 4. VIII. 2006 (J.H. Jin); 4 ♀, Mt. Chiak, 5. VIII. 1998, 1 ♀, Pandae-ri, Wonju, 4. VIII. 1998 (Ahn & Kim). [GG] 1 ♀, Mt. Hwaak, 19. VIII.

1998 (Paek, Lee & Kim); 3♂, 2♀, ditto, 25. VIII. 1998 (Paek, Lee & Ahn); 1♀, Mt. Soyo, 15. VIII. 1996 (Paek, Lee & Ahn); 1♂, 9♀, ditto, 7. IX. 1996. (M.K. Paek & B.W. Lee); 1♀, Munsan, Paju, 27. VII. 2003 (J.H. Jin); 1♀, Mulwang reser., Shiheung, 10. VII. 1996, 1♂, 5♀, 30. VII. 1996 (M.K. Paek); 1♂, 9♀, ditto, 17. IX. 1997 (M.K. Paek & N.H. Ahn); 8♀, Mt. Yongmun, 11. VIII. 1998 (Lee, Ahn & Kim); 1♀, Yangsu-ri, Namyangju, 23. VIII. 2005 (J.H. Jin); 1♀, Mt. Gyeongyang, Incheon, 3. VIII. 2005, 1♀, 8. IX. 2006 (J.H. Jin); 1♂, 3♀, Is. Yongyu, Incheon, 28. VIII. 1997 (M.K. Paek & N.H. Ahn); 1♀, Suwon, 2. VI. 1961 (H.H. Lee); 1♀, ditto, 1. VII. 1964 (H.C. Y); 1♀, ditto, 13. VII. 1964 (S.B. Ahn); 1♀, ditto, 31. VII. 1964 (K.T. Park); 1♀, ditto, 31. VII. 1969 (H.C. Y); 1♀, ditto, 18. VIII. 1969 (H.H. Lee); 1♀, ditto, 7. V. 1972 (H.C. Y); 1♀, ditto, 7. IX. 1973 (H.K. Kim); 1♀, ditto, 4. X. 1973 (K.T. Park); 1♀, ditto, 10. IX. 1974 (J.C. Park); 1♀, ditto, 10. IX. 1974 (Y.I. Lee); 1♀, ditto, 22. VIII. 1974, 1♀, 23. VII. 1974 (K.T. Park); 1♀, ditto, 28. VIII. 1974 (Y.I. Lee); 1♀, ditto, 28. VIII. 1974 (K.T. Park); 1♀, ditto, 28. VIII. 1974 (Ryu); 1♀, ditto, 10. VIII. 1975, 2♀, 9. IX. 1975, 1♀, ditto, 16. IX. 1976, 1♀, ditto, 30. VIII. 1976 (K.T. Park); 1♀, ditto, 15. IX. 1978, 1♀, 11. VIII. 1980 (K.R. Choe); 1♀, ditto, 26. VIII. 1981 (S.W. Lee); 1♀, ditto, 22. IV. 1982 (N.S. Cho); 1♀, ditto, 22. VII. 1982, 1♀, 23. VII. 1982, 1♀, ditto, 24. VII. 1982, 1♀, 11. VIII. 1982, 1♀, 12. VIII. 1982, 1♀, 13. VIII. 1982, 1♀, 16. VIII. 1982 (C.H. Ryu); 1♀, ditto, 24. VIII. 1982 (D.J. Im); 1♀, ditto, 29. VIII. 1982, 1♀, 30. VIII. 1982 (C.H. Ryu); 1♀, ditto, 29. VIII. 1984 (S.W. Lee); 1♀, ditto, 25. VIII. 1985 (S.B. Ahn); 1♀, Mt. Yeogi, Suwon, 16. IX. 1991 (B. L.); 1♀, Dongbang reser., Hwaseong, 27. VII. 2004, 1♀, Myeoguji reser., Hwaseong, 3. IX. 2006 (J.H. Jin); 1♂, 3♀, Daeseong reser., Hwaseong, 3. VII. 1998 (M.K. Paek & B.W. Lee); 1♀, Is. Deokjeok, 31. VII. 1998 (Paek, Ahn & Kim); 1♀, Pyeongtaeg, 8. VIII. 1975 (K.T. Park). [CB] 1♀, Geumseong, Jecheon, 2. IX. 2006 (J.H. Jin); 1♀, Gageum, Chungju, 16. VIII. 2006 (J.H. Jin); 1♀, Majeumagjae, Chungju, 20. VIII. 2006 (J.H. Jin); 1♀, Munui, Cheongweon, 23. IX. 2006 (J.H. Jin); 1♀, Mt. Ingyeong, Cheongweon, 23. VIII. 1997 (Y.S. Bae); 161

♂, 1♀, Oksan, Okcheon, 31. VIII. 1996 (M.K. Paek); 2♀, ditto, 20. IX. 1996 (Bae, Paek, Lee & Paek); 1♀, Yeongdong, 16-20. IX. 1991 (R.G.O). [CN] 1♀, Mt. Manroe, 1. VIII. 1998 (Y.S. Bae); 1♀, Sungweon reser., Taean, 11. VII. 1996, 3♀, 16. VII. 1996 (M.K. Paek); 14♀, Chupungryeong, 30. VIII. 1996 (M.K. Paek). [GB] 1♀, Yongdam-ri, Sangju, 16. VIII. 2006 (J.H. Jin). [GN] 1♀, Milyang, 1. V. 1973 (H.K. Kim); 6♂, 1♀, Upo-swamp, Changnyeong, 3. X. 1997 (M.K. Paek); 17♂, 129♀, ditto, 17. VIII. 2006 (J.H. Jin); 1♀, Jusang, Geochang, 23. VIII. 1997, 10♂, 8♀, 14. VIII. 1998 (M.K. Paek); 1♀, Jinju, 13. IX. 1986 (S.B. Ahn). [JN] 1♂, 1♀, Mt. Jiri, Jungsan-ri, 20. VII. 1996 (Bae, Paek & Lee); 1♀, Naju, 30. VI. 1983 (D.J. Im); 1♀, Yeondong-ri, Haenam, 7. V. 2004 (J.H. Jin); 1♀, Mt. Baegun, Gwangyang, 19-20. VIII. 1972 (S.B. Ahn).

Distribution. Korea (GW, GG, CB, CN, GB, GN, JN), Japan, China, Amur, Ussuri, Taiwan.

Habitat and Biology.

This species is multivoltine. The host plants of this species are reported by Park (1983) and Bae *et al.* (2006) as follows: *Hydrocharis dubia*, *Spirodela polyrhiza*, *Trapa japonica*, and *Glycine max*. In this study, we found damage of the leaves of *Lemna perpusilla* and *Salvinia natans* as new host plants in Korea. *Spirodela polyrhiza*, *Hydrocharis dubia*, *Trapa japonica*, *Nymphaea* spp. and *Azolla* sp. are known in Japan (Yoshiyasu, 1985). The larvae of this species are mainly found on *Spirodela polyrhiza*, *Salvinia natans*, and *Lemna perpusilla* in Korea. The eggs are laid on the underside of the leaf as in *Elophila interruptalis* (Pryer, 1877). The mean number of the eggs in a mass is 30. The 1st instar larvae mine the leaves or enter the space between the two leaves of hosts. The 2nd instar larvae cut off the small pieces from the leaf to make the portable cases, and feed on the surface of the hosts. The 3rd instar larvae enlarge the cases by adding another fragments of leaves to older ones, and the water resistant structures are developed on the surface of the body. The 4th and the last instar larvae make the larger cases than preceding instar in proportion to the growth of larvae by gathering many

pieces of leaves. The pupation takes place in the case of host plants. The adults and larvae appear from the end of April to the beginning of October in Korea.

Remarks. This species is very similar to *E. interruptalis* (Pryer) in the distributional and biological aspects, but can be distinguished from the latter by the eggs underside of the host leaves in fan-shaped mass and the larval case by two cut pieces of the leaves. *E. turbata* is the common species among the Korean nymphulinae moths and distributed throughout the country.

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