

# THE MORPHOLOGY OF MATURE LARVAE OF THREE ENNOMINAE SPECIES IN KOREA (LEPIDOPTERA: GEOMETRIDAE)

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(Received Nov. 28, 2002; accepted Mar. 5, 2003)

**Abstract** The larval external morphologies of *Ectropis crepuscularia* (Denis & Schiffermüller), *Zamacra juglansiararia* (Graeser) and *Phigalia verecundaria* (Leech) of Ennominae are described and illustrated.

**Key words** larval morphology, Ennominae, Geometridae, Lepidoptera, Korea.

## 1 INTRODUCTION

Many geometrid larvae have at least four SV setae (SV1, 2, 3 on proleg, SV4 on body wall), and often bear one secondary SV seta, setae L1 and L2 widely separate on A1-8 and L3 more anterior than the usual position in Lepidoptera.

Issiki (1969) briefly described color pattern and majority chaetotaxy of *Zamacra juglansiararia*, *Phigalia verecundaria* and other larvae of the Geometridae.

The Geometridae are large, more than 527 species are known from Korea (Check List of Insects from Korea 1994). The immature stages of many species are still unknown. Modern taxonomy use characters from larvae and pupae for taxonomic study, but the features of Geometridae larvae have not considerably identified in Korea. Therefore, the larvae of three collected species were observed. We here provide detailed descriptions and illustrations of the larvae of *Ectropis crepuscularia*, *Zamacra juglansiararia* and *Phigalia verecundaria*.

## 2 MATERIALS AND METHODS

The morphological features of mature larvae in alcohol were examined. Then, they were macerated in 10% KOH for several minutes and dissected un-

der stereoscopic microscope (40×). The head capsule with attached mouthparts was first removed from the body by a cut made with fine forceps around the edges of the occipital foramen. The maxillae and labium as a unit were removed from the head capsule. The head was sketched under this condition from dorsal and ventral sides. Then the mandibles with attached tendons were removed from the head capsule. Mouthparts and skins were mounted on microscopic slides for detailed examinations (100× or 150×).

The nomenclature of larvae setae and puncture follows Hinton (1946), and the terminology of labrum, maxillary lobe, and palpi follows Heinrich (1916), Grimes and Neunzig (1986a, b).

## 3 DESCRIPTION

### Genus *Ectropis* Hbner, 1825

*Ectropis crepuscularia* (Denis & Schiffermüller)  
(Figs. 1 - 8)

Body stout, usually yellow, and covered with profusion of diffuse, brown to blackish brown freckles, dorsum of A8 with brownish yellow saddle, and hints of saddle bearing seta D1. Head yellow, post-teral and lateral area having black maculation, thoracic legs reddish yellow with brown claws; spiracles yellow with black peritremes.

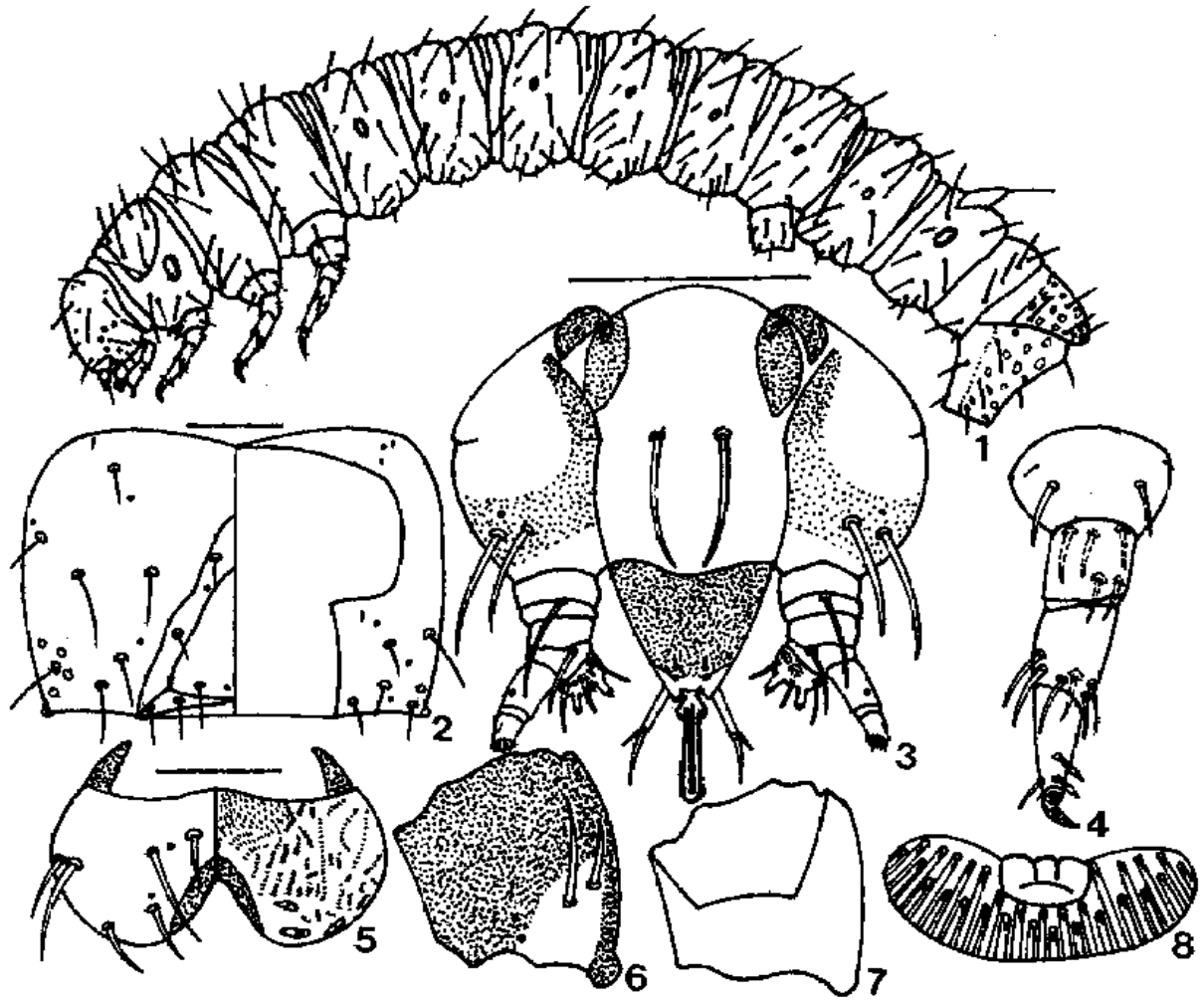


Fig. 1 - 8 *Ectropis crepuscularia* (Denis & Schiffermüller).

1. Larva; 2. head (dorsal and ventral view); 3. maxillae and labium; 4. thoracic leg; 5. labrum and epipharynx; 6. mandible (dorsal view); 7. mandible (ventral view); 8. crochets of A6 and A10. scales; 0.5 mm.

Head. Almost rectangular, ocelli I-IV forming a semi-circle and evenly placed. The apex of adfrontal sutures midway between vertical triangle and front apex. A1, A2 and A3 forming an obtuse angle at A2.

Mouthparts. Labrum emargination three-sevenths deep, forming a normal arc, M2 slightly lateroventral to M1; L1 and L2 closely approximate, L1 slightly laterodorsal to L2. Epipharynx has small spines. Mandible with five apical teeth on cutting edge, the first, second and third teeth small, fourth and fifth teeth apical blunt. Labium having membranous postmentum with two conspicuous setae;

mentum sclerotized and black; prementum with median spinneret distally and labial palpi laterally; spinneret apical rounded, about 10 times as long as median breadth and longer than tip of seta on apical segment of labial palpi. Maxillae: cardo mostly membranous, with hook-like sclerites basally; stipes mostly membranous, with brown marking and two setae; palpifer sclerotized and with one seta. Palpus: basal segment having one seta and a lobe, on the lobe with two sensilla styloconica, three sensilla trichodea, and two sensilla basiconica and one puncture; median segment slightly longer than apical segment and with one puncture; apical segment

with eight sensilla basiconica.

Thorax. T1 : D1 and D2 directly behind from XD1 and XD2, respectively; SD1 and SD2 close approximate, SD1 thinner than SD2; L1 and L2 anteroventral to spiracle, L2 thinner than L1; SV1 and SV2 present above leg. T2 and T3 : setae D2 and SD1 anteroventral to D1 and SD2, respectively; SD1 hair like; L1, L2 and L3 present; SV group unisetose. Thoracic leg : coxa with seven setae; femur with two setae; tibia with six setae and one puncture; tarsus with four setae (one thick seta, two lanceolate setae, and one narrow seta).

Abdomen. On A1-8, D1 slightly anterodorsal to D2; SD1 anterodorsal to spiracle on A1-6 and A8, straight dorsal to spiracle on A7; SD2 anterodorsal to spiracle on A1-7, anterior to spiracle on A8; L1 directly lateral to spiracle in A1, posteroventral to spiracle in A2-8; L2 anteroventral to spiracle; L3 posteroventral to L2 on A1-5 and A8, straight below from L2 on A6-7; SV3 slightly posteroventral to L3 on A1-6 and almost directly behind on A7. SV group trisetose on A1, four setae on A2-5, six setae on A6, bisetose on A7, and unisetose on A8; on A1, SV1 straight below SV4 and forming a near straight line with V1; on A2-5, SV1 posteroventral to SV4, setae SV4, SV1 and V1 arranged in a triangle. On A9, setae D2, D1, SD1, L1 and SV1 arrange in a nearly straight vertical line. Anal shield rounded posterior; anal leg with nine setae and one puncture, lateral seta straightly arranged, L1 most dorsal, L3 most ventral. Prolegs on A6 and A10, crochets biordinal, arranged in a homioideous mesoseries and frequently reduced near the middle by a sucker. All spiracles widely oval, those of T1 and A8 about the same size and larger than the others, spiracles of A1 and A7 slightly larger than those of A2-6.

Larva length : 36 ~ 41 mm; Head width : 3.8 ~ 4.2 mm.

Materials examined : Mature larvae collected from leaves of *Pterocarya stenoptera* DC at Experiment Forest of Kangwon National University, Chunchon City, Kangwon Do, 30. VIII 1997.

This species may be characterized by the dor-

sum with a large hump on A8; the almost rectangular head; and the mandible with five blunt teeth.

### Genus *Zamacra* Meyrick, 1892

*Zamacra juglansiararia* (Graeser) (Figs. 9 - 15)

Body stout, long, and blackish brown or dark brown; thoracic sub-dorsal line bear slender and white stripe; the dorsal areas on A1-4 and A8 have conical tubercles with seta D1; the dorsal area on A1-4 (except for this tubercles margins) and A8 (except for the somewhat postal margin) white; the white spots reaching from posterior margin of A7 to lateral line of A6; super-ventral line with white stripe; ventral area light. Head dark brown, lateral view has slender yellowish white stripes irregularly; thoracic shield, anal shield and thoracic legs brown; spiracles brown with black peritremes.

Head. Ocellus I the largest, ocelli FIV evenly placed in a semicircle. The distance from vertical triangle to apex of adfrontal ecdysial line shorter than to the distance from apex of ecdysial line to apex of frontal sutures; front extends about two-thirds of the distance to vertical triangle. A1, A2 and A3 forming an obtuse angle at A2.

Mouthparts. Labrum emargination about half deep, forming a normal arc; M2 lateroventral to M1; L1 and L2 not approximate, L1 laterodorsal to L2. Epipharynx has small spines. Mandible with nine apical teeth, the second to fifth teeth apical blunt. Labium having membranous postmentum with two conspicuous setae, a dark pigmentation around them; mentum sclerotized; prementum with median spinneret distally and labial palpi laterally. Spinneret short, tube-shaped, apical blunt, the length slightly larger than the width, and shorter than tip of seta on apical segment of labial palpi. Maxillae : cardo mostly membranous with hook-like sclerites basally; stipes mostly membranous, with black sclerites and two setae; palpifer sclerotized and with one seta. Palpus : basal segment having one seta and a lobe, on the lobe with three sensilla trichodea, two sensilla styloconica, and two sensilla basiconica and one puncture; median segment distinctly longer than apical segment and with one

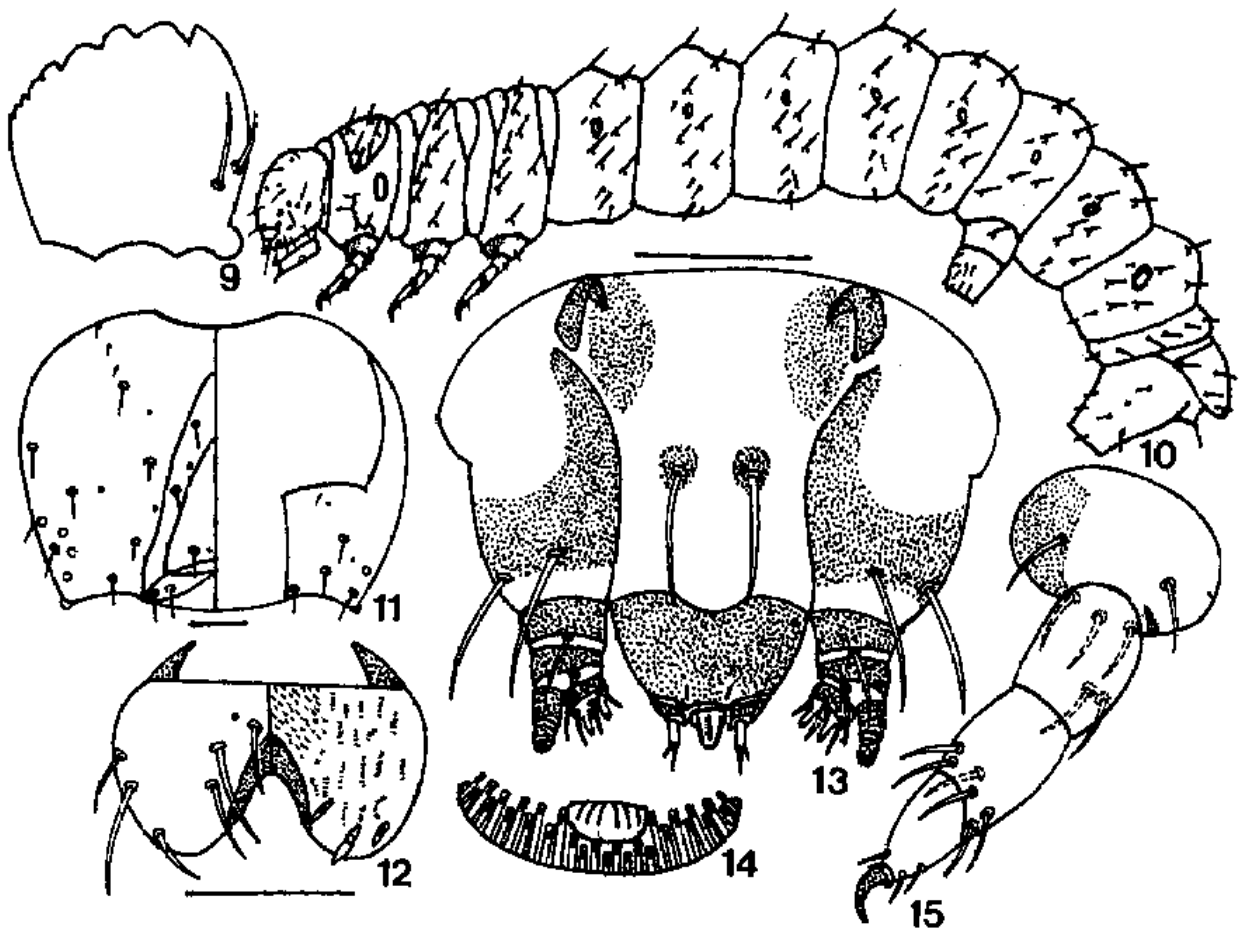


Fig. 9 - 15 *Zamacra juglansiaris* (Graeser).

9. Mandible (dorsal view) ; 10. larva ; 11. head (dorsal and ventral view) ; 12. labrum and epipharynx ; 13. maxillae and labium ; 14. crochets of A6 and 10 ; 15. thoracic leg. scales : 0.5 mm.

puncture; apical segment with eight sensilla basiconica distally.

Thorax. T1: D1 closer to D2 than to XD1; SD1 thinner than SD2; L1 and L2 anteroventral to spiracle, L2 thinner than L1; SV1 and SV2 present above leg. T2 and T3: setae D1, D2 and SD2 arranged vertical line; SD1 anteroventral to SD2 and hair like; L1, L2 and L3 present; SV group unisetose. Thoracic leg: coxa with seven setae; femur with two setae; tibia with six setae and one puncture, tarsus with four setae.

Abdomen. On A1-8, D1 anterodorsal to D2; SD1 dorsal to spiracle; SD2 anterodorsal to spiracle in A1-6, anterior to spiracle on A7-8; L1 lateral to spiracle in A1, lateroventral to spiracle on A2-8;

L2 slightly anteroventral to spiracle; L3 posteroventral to L2 on A1-5 and A8, anteroventral to L2 on A6, straight below L2 on A7; SV3 caudal to L3 on A1-5 and A7, lateroventral to L3 on A7; SV group trisetose on A1, four setae on A2-5, eleven setae on A6, tisetose on A7, unisetose on A8. Setae SV4, SV1 and V1 on A1 forming an almost curved line, on A2-5 arranged in a triangle. On A9, setae D2, D1, SD1, L1 and SV1 forming an almost vertical line. Anal shield rounded posterior; anal leg with nine setae and one puncture, lateral setae straight arranged, L1 most dorsal and L3 most ventral. Prolegs on A6 and A10, crochets biordinal, arranged in a homioideous mesoseries, frequently interrupted by a fleshy lobe. All spiracles broadly oval, those on

T1 and A8 of about same size and larger than others, spiracles of A1 and A7 slightly larger than those on A2-6.

Larva length: 38 ~ 41 mm; Head width: 3.3 ~ 3.7 mm.

Materials examined: Mature larvae collected from leaves of *Zelkova serrata* Makino at Experiment Forest of Kangwon National University, Chunchon City, Kangwon Do, 27. V. 1999.

This species is characterized by the dark pigmentation around two postmentum setae of labium; the spinneret apical blunt, tube-shaped and short; the body setal base tubercles; on A1-4 and A8, the

seta D1 tubercles large; and the mandible with nine blunt teeth.

### Genus *Phigalia* Prout, 1915

*Phigalia verecundaria* (Leech) (Figs. 16 - 22)

Body dorsal area yellowish brown; dorsal line with a pair slender and black stripes; sub-dorsal line and lateral line with two black stripes irregularly, sometimes fused this black marking; on A1-4 and A8 with distinct black marking; super-spiracle line and spiracle line with indistinct black stripes; spiracle margin with brown spots, spiracle anterior-ventral view with one yellow spot; body ventral area

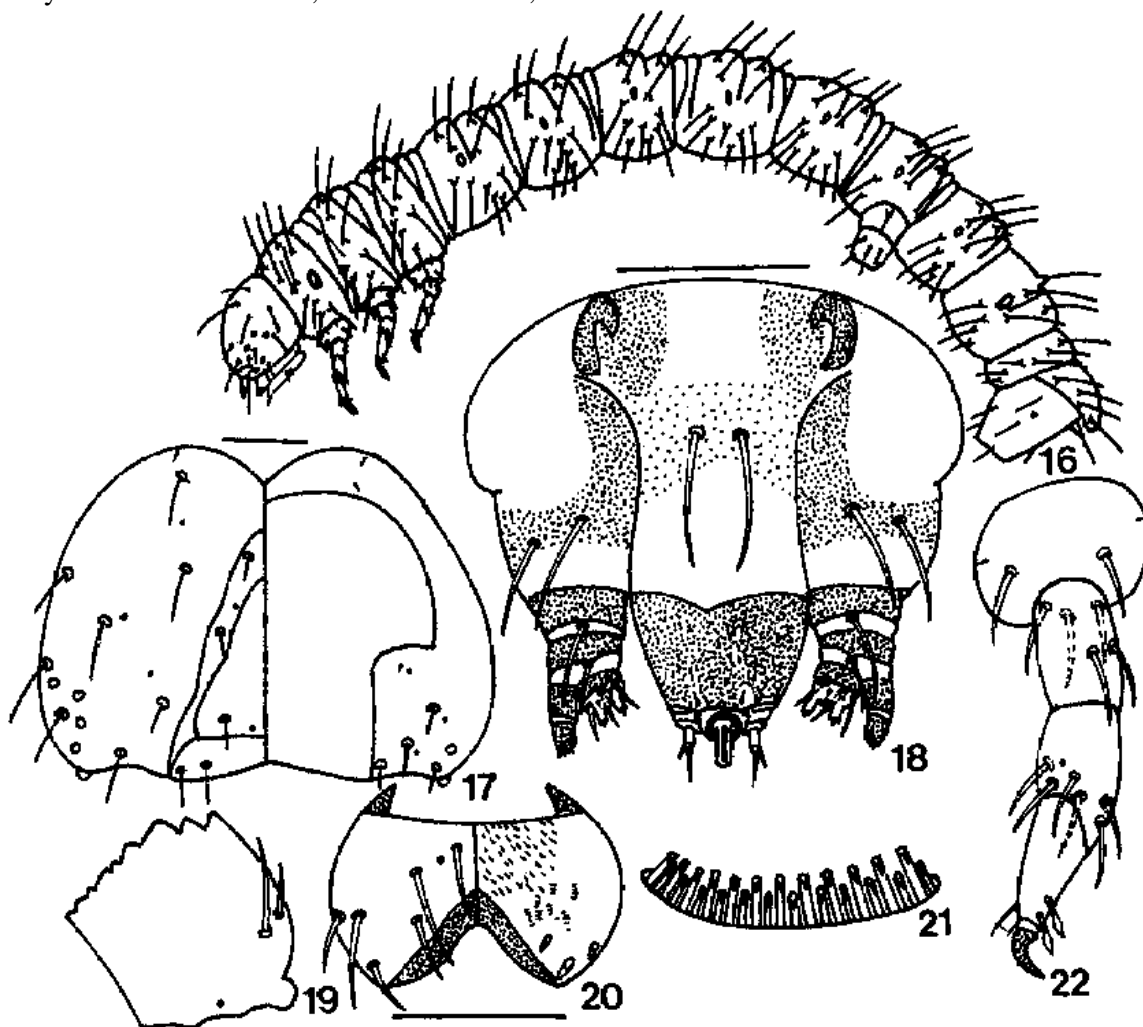


Fig. 16 - 22 *Phigalia verecundaria* (Leech).

16. Larva; 17. head (dorsal and ventral view); 18. maxillae and labium; 19. mandible (dorsal view); 20. labrum and epipharynx; 21. crochets of A6 and A10; 22. thoracic leg. scales: 0.5 mm.

light brown; mid-ventral line yellowish white. Head black; thoracic shield and anal shield of body color, thoracic legs brown; cuticle with spinulation and small hair, setae base tubercle; spiracles yellow with black peritremes.

Head. Ocelli FIV evenly placed in semi-circle. The apex of adfrontal ecdysial line midway between vertical triangle and apex of front, adfrontal sutures close to front margin; front extends about two-thirds of the distance to vertical triangle. A1, A2 and A3 forming an obtuse angle at A2.

Mouthparts. Labrum emagination about one-third deep, forming a normal arc; M2 lateroventral to M1; L1 and L2 close approximate, L1 directly lateral to L2. Epipharynx has small spines. Mandible with nine apical teeth on cutting edge. Labium having membranous postmentum with two conspicuous setae, a dark pigmentation around them; mentum sclerotized; prementum with median spinneret distally and labial palpi laterally. Spinneret apical rounded, about 2 times as long as the median breadth and slightly shorter than tip of seta on apical segment of labial palpi. Maxillae:cardo mostly membranous with hook-like sclerites basally; stipes mostly membranous, with a large sclerite and two setae; palpifer sclerotized and with one seta. Palpus: basal segment having one seta and a lobe, on the lobe with three sensilla trichodea, two sensilla styloconica, and two sensilla basiconica and one puncture, median segment longer than apical segment and with one puncture; apical segment with eight sensilla basiconica distally.

Thorax. T1: D1 closer to D2 than to XD1; SD1 and SD2 approximate, SD1 thinner than SD2; L1 and L2 anteroventral to spiracle, L2 thinner than L1; SV1 and SV2 present above leg. T2 and T3: D1, D2 and SD2 forming a straight vertical line; SD1 anteroventral to SD2 and hair like; L1, L2 and L3 present; SV group unisetose. Thoracic leg: coxa with seven setae; femur with two setae; tibia with six setae and one puncture; tarsus with four setae (one thick seta; two lanceolate setae; one narrow seta).

Abdomen. On A1-8, D1 anterodorsal to D2;

SD1 dorsal to spiracle in A1 and A6-8, anterodorsal to spiracle on A2-5; L1 caudal to spiracle on A1, lateroventral to spiracle in A2-8; L2 anteroventral to spiracle; L3 lateroventral to L2 on A1-2 and A7-8, straight below L2 on A3-5; SV3 caudal to L3 on A1-7; SV group trisetose on A1, four setae on A2-5, six setae on A6, bisetose on A7, unisetose on A8. Setae SV4, SV1 and V1 on A1 and A2 forming an almost straight line, on A3-5 arrange in a triangle. On A9, setae D2, D1, SD1, L1 and SV1 forming a vertical line. Anal shield rounded posterior; anal leg with nine setae and one puncture, lateral setae straightly arranged, L1 most dorsal and L3 most ventral. Prolegs on A6 and A10, crochets biordinal, arranged in a homoideous meso-series. All spiracles broadly oval, those on T1 and A8 of about the same size and larger than others, spiracles on A1 and A7 slightly larger than those on A2-6.

Larva length: 24-29 mm; Head width: 2.5-2.8 mm.

Materials examined: Mature larvae collected from leaves of *Zelkova serrata* Makino and *Quercus aliena* B1 at Experiment Forest of Kangwon National University, Chunchon City, Kangwon Do, 27. V. 1999.

This species may be characterized by the body setae arise tubercles; D1 tubercle is large on A8; a dark pigmentation around two postmentum setae of labium; and the thoracic legs with two lanceolate ventral setae near claw.

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## 韩国枝尺蛾亚科三种幼虫形态记述(鳞翅目:尺蛾科)

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详细地记述了枝尺蛾亚科鞍形埃尺蛾 *Ectropis crepuscularia* (Denis & Schifferrmller)、胡桃褶翅尺蛾 *Zamacra juglansiaria* (Graeser)及 *Phigalia verecundaria* (Leech) 幼虫的形态特征,并提供了形态特征图。

关键词 幼虫形态 枝尺蛾亚科 尺蛾科 鳞翅目 韩国