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Description of the Immatures of the Tiger Beetles (Coleoptera: Cicindelidae) from Taiwan (I)

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ABSTRACT

The immature stages, including egg, larval instars I to III and pupa, of five cicindeline species from Taiwan are described and illustrated. They are *Calomera angulata* (Fabricius, 1798), *Cicindela* (*Cylindera*) *sauteri* (Horn, 1912), *Cylindera* (*Ifasina*) *kaleea* (Bates, 1866), *Cylindera* (*Eugrapha*) *elisae formosana* (Minowa, 1932) and *Myriochile speculifera* (Chevrolat, 1845). The habitat conditions for larvae use are also described.

Key words: Cicindelidae, immature morphology, habitat, Taiwan

Introduction

More than 2,600 species of Cicindelidae are recorded (Pearson and Cassola, 2005). As with many other groups of insects, the immatures of the tiger beetles have not been as well studied as the adults (Knisley and Schultz, 1997), especially those in the tropical groups (Arndt *et al*., 1996). The larvae of tiger beetles are carnivorous, they dig a burrow perpendicular to the soil in which they then sit and wait for their pray. Because the larvae of tiger beetles are epigeal, it is not easy to find them in the field, which increases the difficulty of studying them.

Researching their immature stages can help to further understand the taxonomy, ecology, behavior and phylogeny of the tiger beetles (Putchkov and Cassola, 1994). Currently, there are only two papers dealing with the larvae of tiger beetles in Taiwan (Wu *et al*., 2006; Putchkov *et al*., 2008).

The aim of this paper is to extend the knowledge of tiger beetle larvae in Taiwan.

Materials and Methods

This study used a series of larvae specimens from the author's collections which were collected during 2002-2003 and 2008-2011. All specimens were preserved in 75% ethanol solution. Measurements were taken using a stereomicroscope (WILD MZ8) and the aid of an eyepiece graticule.

The third instar larvae and pupae described in this study were either laboratory-reared or field-collected (see

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Table 1. Sources of larvae and pupate specimens

Stages	*C. angulata*	*C. sauteri*	*C. kaleea*	*C. elisae formosana*	*M. speculifera*
3rd instar larvae[1]	F, R	F	F	F, R	F, R
Pupae (ex-larvae)[2]	LF, LR	LF	LR	LR	LF

[1] F = field collected; R = lab. reared.

[2] LF = larvae of field collected; LR = larvae of lab. reared.

Table 1). The first and second instar larvae and eggs were all laboratory-reared.

The identification of tiger beetle larvae that follows is based on specimens that were reared from adults collected in the field, and selected by process of elimination, according to size and knowledge of adult habitats (Knisley and Pearson, 1984). The nomenclature follows Rivalier (1971), Wiesner (1992) and Werner *et al*. (2002). The morphological terminology is as reviewed by Hamilton (1925); Knisley and Pearson (1984) and Putchkov and Cassola (1994).

Descriptions

All species described below belong to the subtribe Cicindelina whose larvae can be diagnosed by: Palpiger area divided with distinct sclerite, basal segment of labial palpus with spine-like projections, distal segment in the middle with a single seta. Gular suture T- shaped.

***Calomera angulata* (Fabricius, 1798)**
雲紋凸緣虎甲蟲

Instar III (n = 13)

Collecting locality:

CHIAYI County: Yizhu Township, Housheng Bridge, 14 II 2010 x 1, 7 IX 2010 x 3, 28 IX 2010 x 1. HUALIEN County: Ji-an Township Hualien Bridge, 20 II 2003 x 2; Rueisuei Township, Cimei, 19 II 2003 x 1; Rueisuei Bridge, 19 II 2003 x 1; Yuli Township, Yuli Bridge, 18 II 2003 x 1. PINGTUNG County: Ligang Township Liling Bridge, 9 XII 2002 x 1, 30 I 2003 x 1, 31 I 2003 x 1.

Measurements: (see Table 2)

Coloration: Head blackish brown with coppery reflection; mandible reddish brown, but blackish brown distally; antennae brown; pronotum brown, middle line with purplish coppery luster; setae on head and pronotum white to pale yellow; setae on abdomen light brown.

Head (Fig. 1A): Dorsal surface setae prominent, varying in length; nasale trapezoidal, transverse at apex and slight longitudinal grooves with setae at base, limited on outer sides by teeth-like produce; U-shaped ridge on frons with two setae and separated from ridge on vertex; coronal suture short; antennae (Fig. 1C, D), antennomere I with 6-7 setae; antennomere II with 8-9 setae; length ratio of antennal segments = 1: 1.38: 0.95: 0.63; maxillae (Fig. 1F), stipes slender, inner margin with a row of setae and two spines on base; length ratio of maxillary palpi = 1: 1.45: 2.08; galeomere I with three setae on inner margin apically; length ratio of galeae =1: 0.66; labium (Fig. 1E), palpiger area divided with distinct sclerites; basal labial palpomere with six bristles at apex, middle three spine-liked; distal labial palpomere with a single seta at the middle.

Pronotum (Fig. 1B): Anterolateral angles produced with apices slightly acute, extending as far cephalad as the mesal portion; lateral margins with marginal setae; pronotal surface intermixed with 8-9 long and 20-30 short setae on each half; disc depressed distinctly.

Abdomen: Tergite III (Fig. 1G) with 6-10 setae; tergite V (Fig. 1H) ; anterior sclerite with 5-7 setae; lateral sclerite with four setae; posterior sclerite (Fig. 1K) with 25-30 bristles, of which 20-25 spine-like;

Table 2. Measurements of larval specimens

	Instar	*C. angulata*	*C. sauteri*	*C. kaleea*	*C. elisae formosana*	*M. speculifera*
Width of head	L1	2.96 ± 0.12	2.10 ± 0.08	1.85 ± 0.08	2.18 ± 0.08	2.56 ± 0.02
	L2	2.12 ± 0.05	1.30	1.12	1.46 ± 0.07	1.44
	L3	1.39 ± 0.03	0.89	0.73 ± 0.02	1.05 ± 0.01	1.15 ± 0.12
Width of pronotum	L1	2.86 ± 0.13	2.21 ± 0.17	1.90 ± 0.08	2.12 ± 0.09	2.61 ± 0.02
	L2	2.10 ± 0.04	1.3	1.12	1.39 ± 0.10	1.39
	L3	1.31 ± 0.09	0.86	0.72 ± 0.01	0.98 ± 001	1.03 ± 0.04
Length of pronotum	L1	1.82 ± 0.11	1.45 ± 0.12	1.31 ± 0.18	1.37 ± 0.05	1.63 ± 0.18
	L2	1.27 ± 0.05	0.65	0.76	0.86 ± 0.08	0.91
	L3	0.79 ± 0.03	0.53	0.44 ± 0.01	0.60 ± 0.02	0.68 ± 0.00
Length of antennomere I	L1	0.35 ± 0.04	0.23 ± 0.05	0.21 ± 0.02	0.23 ± 0.03	0.29 ± 0.01
	L2	0.20 ± 0.02	0.11	0.09	0.13 ± 0.01	0.15
	L3	0.12 ± 0.02	0.07	0.07 ± 0.01	0.10 ± 0.00	0.08 ± 0.00
Length of antennomere II	L1	0.48 ± 0.02	0.24 ± 0.02	0.20 ± 0.01	0.30 ± 0.03	0.35 ± 0.01
	L2	0.31 ± 0.02	0.15	0.12	0.19 ± 0.01	0.19
	L3	0.17 ± 0.01	0.09	0.06 ± 0.01	0.13 ± 0.00	0.12 ± 0.00
Length of antennomere III	L1	0.33 ± 0.02	0.22 ± 0.02	0.16 ± 0.01	0.22 ± 0.03	0.26 ± 0.03
	L2	0.23 ± 0.01	0.12	0.09	0.14 ± 0.01	0.15
	L3	0.14 ± 0.01	0.09	0.07 ± 0.01	0.10 ± 0.00	0.10 ± 0.00
Length of antennomere IV	L1	0.22 ± 0.01	0.17 ± 0.002	0.11 ± 0.01	0.16 ± 0.03	0.17 ± 0.001
	L2	0.18 ± 0.02	0.13	0.1	0.13 ± 0.01	0.13
	L3	0.13 ± 0.02	0.09	0.07 ± 0.01	0.10 ± 0.00	0.10 ± 0.00
Length of Maxillary palp I	L1	0.10 ± 0.02	0.05 ± 0.00	0.05 ± 0.01	0.06 ± 0.01	0.10 ± 0.00
	L2	0.07 ± 0.01	0.03	0.03	0.04	0.05
	L3	0.04 ± 0.01	0.03	0.02 ± 0.00	0.02 ± 0.00	0.04 ± 0.01
Length of Maxillary palp II	L1	0.15 ± 0.01	0.12 ± 0.02	0.10 ± 0.01	0.10 ± 0.01	0.14 ± 0.00
	L2	0.12 ± 0.01	0.06	0.05	0.06 ± 0.01	0.07
	L3	0.07 ± 0.01	0.04	0.04 ± 0.00	0.04 ± 0.00	0.06 ± 0.00
Length of Maxillary palp III	L1	0.21 ± 0.02	0.15 ± 0.02	0.15 ± 0.02	0.14 ± 0.02	0.22 ± 0.00
	L2	0.17 ± 0.02	0.16	0.09	0.12 ± 0.01	0.12
	L3	0.14 ± 0.01	0.1	0.08 ± 0.01	0.10 ± 0.00	0.12 ± 0.00
Length of galeomere I	L1	0.53 ± 0.03	0.34 ± 0.03	0.30 ± 0.02	0.38 ± 0.02	0.44 ± 0.00
	L2	0.34 ± 0.02	0.21	0.2	0.24 ± 0.02	0.24
	L3	0.22 ± 0.01	0.13	0.11 ± 0.02	0.16 ± 0.01	0.16 ± 0.01
Length of galeomere II	L1	0.35 ± 0.04	0.23 ± 0.02	0.19 ± 0.01	0.24 ± 0.03	0.26 ± 0.00
	L2	0.24 ± 0.02	0.16	0.13	0.16 ± 0.02	0.15
	L3	0.16 ± 0.01	0.11	0.09 ± 0.00	0.12 ± 0.00	0.11 ± 0.01
Length of the inner hook apex	L1	0.05 ± 0.02	0.08 ± 0.01	0.05 ± 0.02	0.03 ± 0.01	0.02 ± 0.00
	L2	0.06 ± 0.01	0.09	0.05	0.04 ± 0.01	0.04
	L3	0.08 ± 0.01	0.06	0.06 ± 0.01	0.04 ± 0.01	0.05 ± 0.01
Entire length of the inner hooks	L1	0.19 ± 0.04	0.20 ± 0.01	0.15 ± 0.02	0.15 ± 0.01	0.25 ± 0.01
	L2	0.17 ± 0.01	0.18	0.11	0.12 ± 0.02	0.15
	L3	0.15 ± 0.02	0.12	0.09 ± 0.01	0.11 ± 0.01	0.11 ± 0.01
Length of the inner hook setae	L1	0.32 ± 0.06	0.16 ± 0.04	0.12 ± 0.02	0.15 ± 0.01	0.13 ± 0.01
	L2	0.23 ± 0.03	0.12	0.09	0.11 ± 0.02	0.12
	L3	0.20 ± 0.02	0.12	0.10 ± 0.01	0.21 ± 0.01	0.10 ± 0.01

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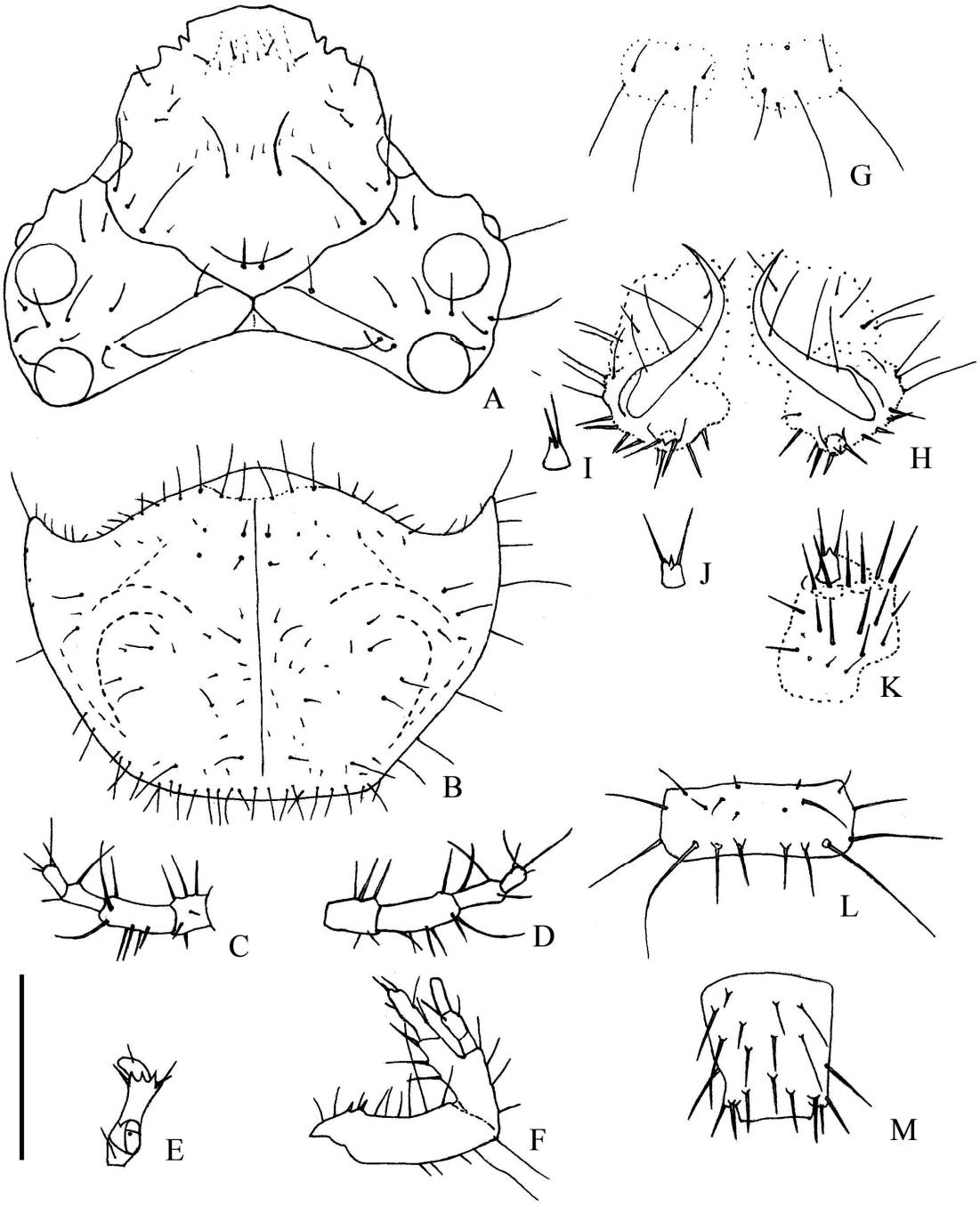


Fig. 1. *Calomera angulata*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) antenna (left, ventral view); E) labium (left, ventral view); F) maxilla(left, ventral view); G) tergite III (dorsal view); H) tergite V (dorsal view); I) inner hook (left, lateral view); J) inner hook (left, caudal view); K) inner hook with posterior sclerite (right part, caudal view); L) tergite IX (dorsal view); M) pygopod (dorsal view). [scale bar = 1 mm].

two pairs of hooks present; median hooks long, slender and arched outwardly with three (rare two) long setae; inner hooks (Fig. 1I, J) conical with two bristles laterally and a small spine at middle; posterior margin of tergite IX (Fig. 1L) with four pairs of bristles, middle two pairs short; pygopod (Fig. 1M) with four pairs of bristles on caudal margin.

Instar II (n = 5)
Collecting locality:
CHIAYI County: Yizhu Township, Housheng Bridge, 14 II 2010 x 3, 7 IX 2010 x 2.
Measurements: (see Table 2)
Coloration: Head brown with coppery luster, around stemmata I and II darkened; mandible blackish yellow, blackish brown toward apex gradually; basal two antennomere brown, upper two blackish brown; pronotum brown with luster; setae on head and pronotum pale yellow, setae on abdomen light brown.
Head (Fig. 2A): U-shaped ridge on frons with two setae; antennae (Fig. 2C), antennomere I with five setae; antennomere II with six setae; length ratio of antennal segments = 1: 1.57: 1.17: 0.91; maxillae (Fig. 2E), length ratio of maxillary palpi = 1: 1.75: 2.59; galeomere I with two setae on inner margin apically; length ratio of galeae = 1: 0.71.
Pronotum (Fig. 2B): Surface intermixed with eight long and 6-10 short setae on each half.
Abdomen: Tergite III (Fig. 2F) with 5-7 setae; tergite V (Fig. 2G), anterior sclerite with 5-8 setae; lateral sclerite with three setae; posterior sclerite (Fig. 2H) with 18-21 bristles, of which 15-17 spine-like; two pairs of hooks present, median hooks long, slender and arched with two long setae in medium part; inner hooks (Fig. 2H) with two bristles laterally and a small spine at middle; posterior margin of tergite IX (Fig. 2I) with four pairs of bristles; pygopod (Fig. 2J) with four pairs bristles on caudal margin.

Instar I (n = 5)
Collecting locality:
CHIAYI County: Yizhu Township, Housheng Bridge, 14 II 2010 x 1, 13 VII 2010 x 1, 23 VII 2010 x 3,
Measurements: (see Table 2)
Coloration: Head with coppery luster, around stemmata I and II darkened; mandible basal half brown, apical blackish brown; antennae brown to blackish brown; pronotum brown; setae on head and pronotum blackish yellow; abdomen setae light brown.
Head (Fig. 3A): Dorsal surface setae varying in length, some bifurcated apically; U-shaped ridge on frons glabrous; antennae (Fig. 3C), antennomere I glabrous; antennomere II with two setae; length ratio of antennal segments = 1: 1.53: 1.28: 1.12; maxillae (Fig. 1E), length ratio of maxillary palpi = 1: 2.04: 4.17; galeomere I with one seta on inner margin apically; length ratio of galeae = 1: 0.70.
Pronotum (Fig. 3B): Surface intermixed with five long and two short setae on each half.
Abdomen: Tergite III (Fig. 3F) with three setae; tergite V (Fig. 3G), anterior sclerite with four setae; lateral sclerite with one seta; posterior sclerite glabrous; two pairs of hooks present, median hooks long, slender and arched with one long seta in medium part; inner hooks (Fig. 3H, I) with two bristles laterally and a small spine at middle; posterior margin of tergite IX (Fig. 3J) with two pairs of setae; pygopod (Fig. 3K) with three pairs bristles on caudal margin.

Egg (n = 2)
Collecting locality:
CHIAYI County: Yizhu Township, Housheng Bridge, 23 VII 2010, 17 IX 2010.
Figure: Length = 1.95-2.33 mm, width = 1.25-1.33 mm; chorion slightly transparent with surface yellowish luster; later developing stage (Fig. 4A, B), appendage and segments completed; earlier developing stage (Fig. 4C, D), head and thoracic also

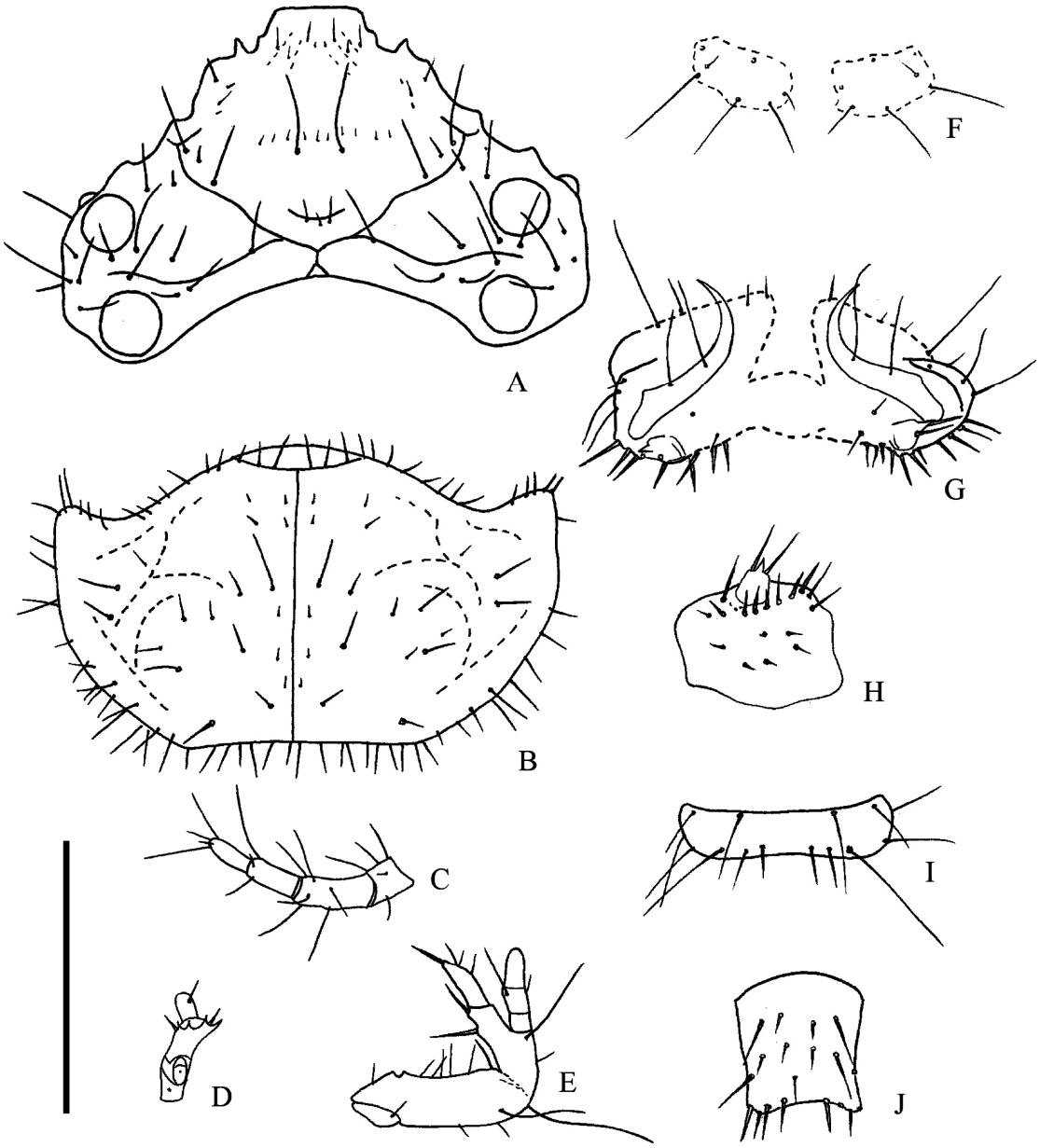


Fig. 2. *Calomera angulata*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook with posterior sclerite (right part, caudal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 1 mm].

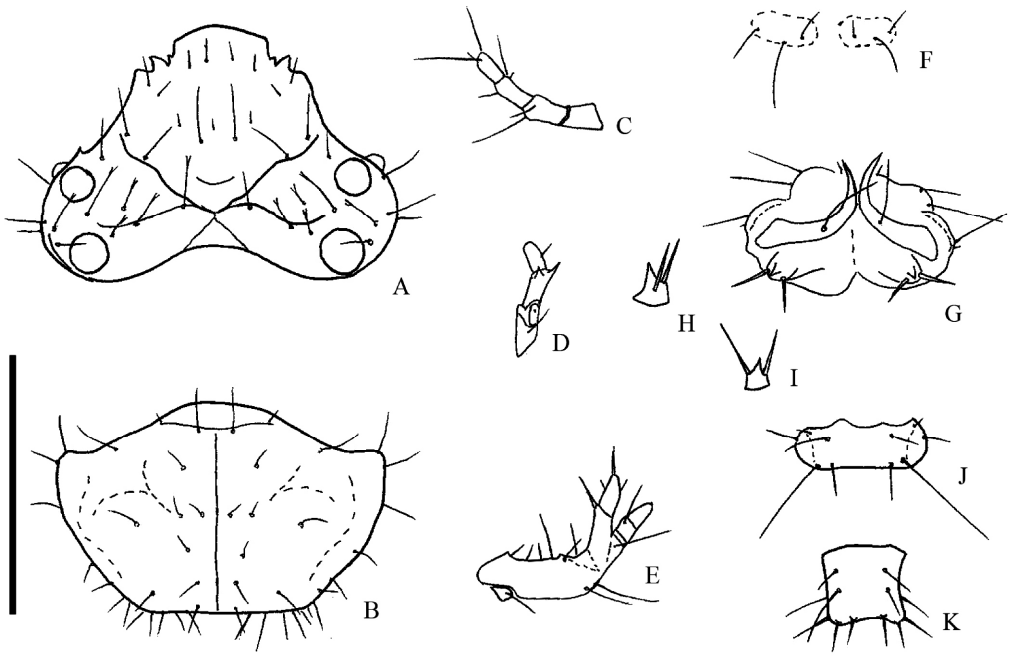


Fig. 3. *Calomera angulata*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna(left, dorsal view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (left, lateral view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 1 mm].

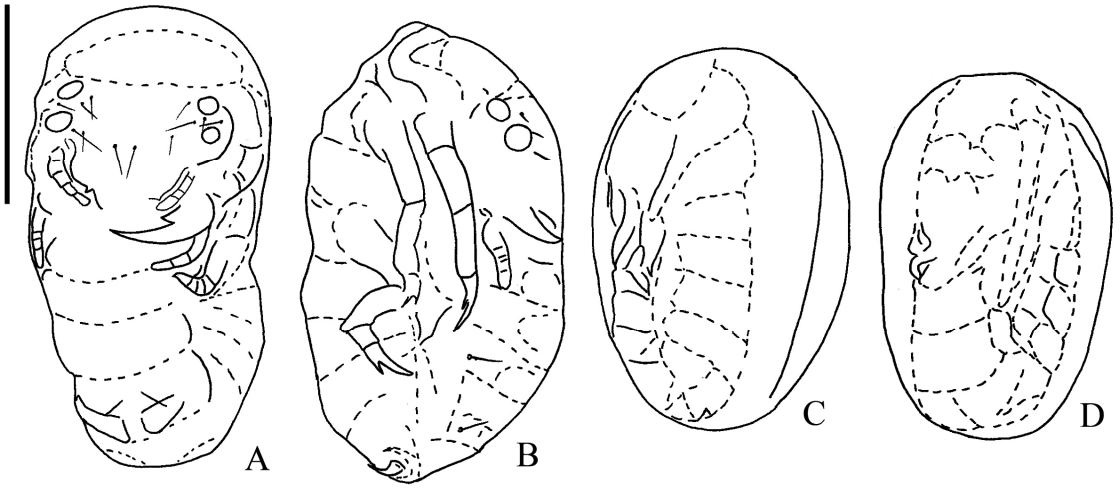


Fig. 4. *Calomera angulata*: Embryos: A) later developing stage (front view); B) later developing stage (lateral view); C) earlier developing stage (lateral view); D) earlier developing stage (front view). [scale bar = 1 mm].

abdominal segmentation nearly completed.

Pupa (n = 2) (Fig. 5A, B)
Collecting locality:
CHIAYI County: Yizhu Township, Housheng Bridge 21 V 2010, 28 IX 2010.
Figure: Length = 9.50-10.60 mm; compound eyes brown to black; antennomere I with green luster; mandible blackish yellow, serration brown with blue luster; pronotum blackish yellow, posterior margin with brown rounded marking at middle; elytra blackish yellow; tergite spurs blackish brown; ventral segments blackish yellow to pale brown; tergites I-V paired dorsal spurs, length of spur IV = 1.05-1.25 mm, apex of spurs I-IV with four setae; length of spur V = 1.60-1.90 mm, apex of spur V each with a ring arrayed by seven setae, a pair of smaller spurs located at inner side of spur V base.
Habitat:

The larvae of *C. angulata* were found on the edge of sandy streams, a habitat that is characterized by the mixture of mainly fine-gravel soils, mud flats and sparse vegetation. The adults are a riparian species, but can also be found near river mouths and sandy flats close to the coast. The species is sympatric with *Cylindera elisae reductelineata* and *C. e. formosana*.

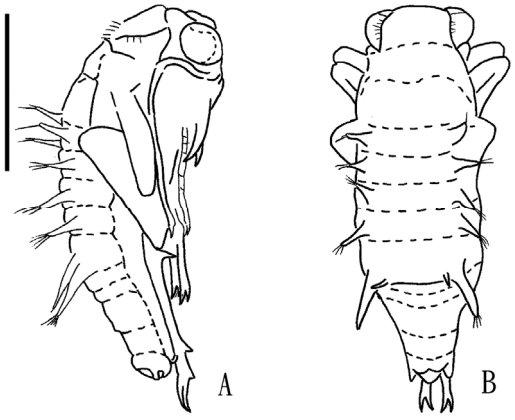


Fig. 5. *Calomera angulata*: Pupa: A) lateral view; B) dorsal view. [scale bar = 4 mm].

***Cicindela* (*Cylindera*) *sauteri* (Horn, 1912)** 梭德氏虎甲蟲
Instar III (n = 6)
Collecting locality:
Nantou County: Yuchi Township, Sun Moon lake, Shueishe Mountain trail alt. 950 m, 8 III 2003 x 2, 18 X 2003 x 2, 28 XII 2003 x 2.
Measurements: (see Table 2)
Coloration: Head blackish brown with reflection; mandible blackish brown, but light brown at base; antennae blackish brown; pronotum blackish brown, anterolateral angles of pronotum light brown; median hooks brown; inner hooks blackish brown; abdomen yellow, sclerites light brown; setae on body light brown.
Head (Fig. 6A). Nasale trapezoid, transverse at apex and slight longitudinal grooves with setae at base, limited on outer sides by teeth-like produce; clypeus with a row of tiny setae and one arc ridge; U-shaped ridge on frons with two setae and separated from ridge on vertex; some setae around stemma I bifurcate; antennae (Fig. 6C, D), antennomere I with five setae, antennomere II with 7-8 setae, length ratio of antennal segments = 1: 1.02: 0.95: 0.73; maxillae (Fig. 6F), inner margin of stipes with a row of setae and one tooth-like tubercle on base, external margin with 1-2 long and several short setae; length ratio of maxillary palpi = 1: 2.33: 3.08; galeomere I with three setae on inner margin apically, length ratio of galeae = 1: 0.69; labium (Fig. 6E), basal segment of with six bristles at apex.
Pronotum (Fig. 6B): Lateral margins with thin setae, at the caudo-lateral angles a cluster of setae (4-5 setae) present, pronotum surface intermixed with 8-9 long and about ten short setae on each half; disc depressed distinctly.
Abdomen: Tergite III (Fig. 6G) with 8-9 setae; tergite V (Fig. 6I), anterior sclerite with 8-10 setae, lateral sclerite with 4-5 setae, posterior sclerite with 23-30 bristles; two pairs of hooks present, median hooks arched with three setae in medium part,

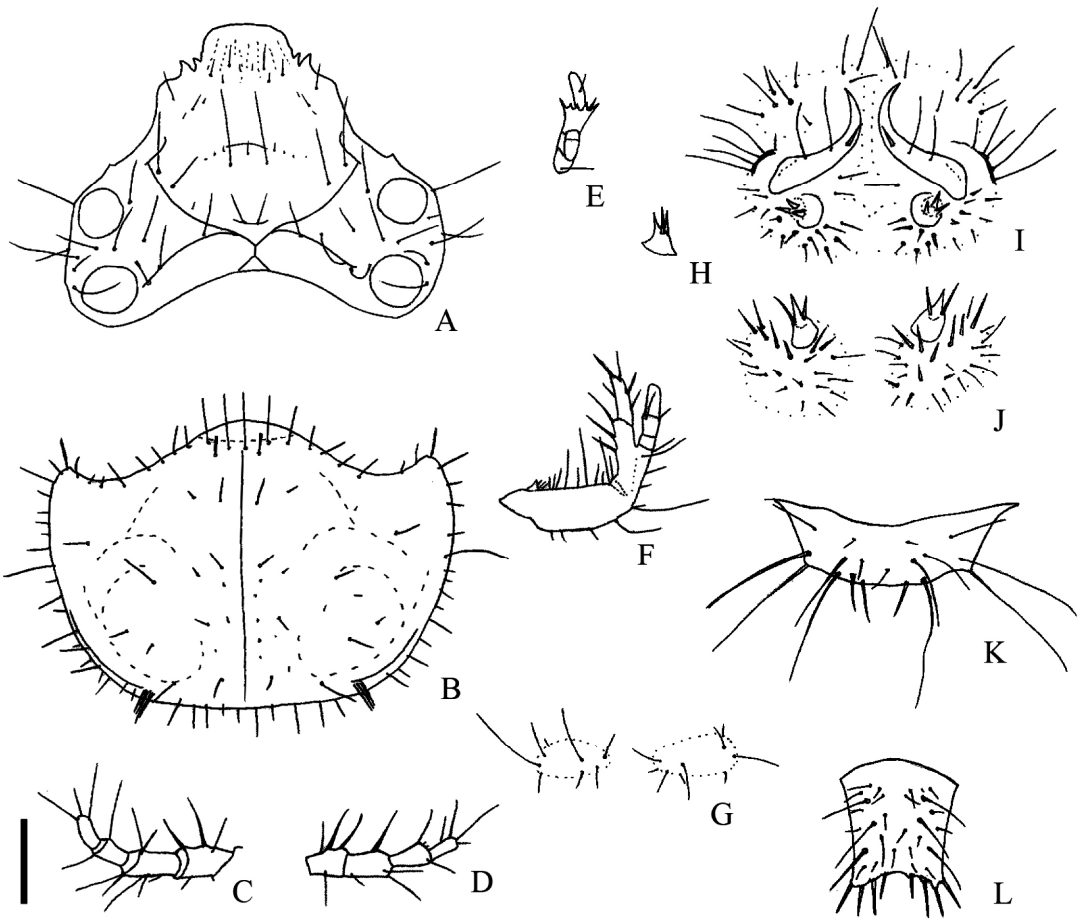


Fig. 6. *Cicindela sauteri*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum(dorsal view); C) antenna (left, dorsal view); D) antenna (left, ventral view); E) labium (left part, ventral view); F) maxilla (left, ventral view); G) tergite III (dorsal view); H) inner hook (left, lateral view); I) tergite V (dorsal view); J) tergite V (caudal view); K) tergite IX (dorsal view); L) pygopod (dorsal view). [scale bar = 0.5 mm].

upper ones thorn-like and inwardly inclined; inner hooks (Fig. 6H, J) conical with two thorn-like bristles laterally and a spine as long as thorn-like bristles at middle; posterior margin of tergite IX (Fig. 6K) with 3-4 pairs of setae, the middle pair shorter; pygopod (Fig. 6L) with four pairs bristles on caudal margin.

Instar II (n = 1)
Collecting locality:
NANTOU County: Yuchi Township, Lianhuachi, 4 X 2010.

Measurements: (see Table 2)
Coloration: Head blackish brown with green reflection; mandible and antennae brown; pronotum brown, anterolateral angles of pronotum light brown; median hooks brown, inner hooks light brown; setae on head, pronotum and abdomen light brown.
Head (Fig. 7A): U-shaped ridge on frons with two setae; setae around stemma I bifurcate; antennae (Fig. 7C), antennomere I with three setae; antennomere II with six setae; length ratio of antennal segments = 1: 1.36: 1.09: 1.18; length ratio of maxillary

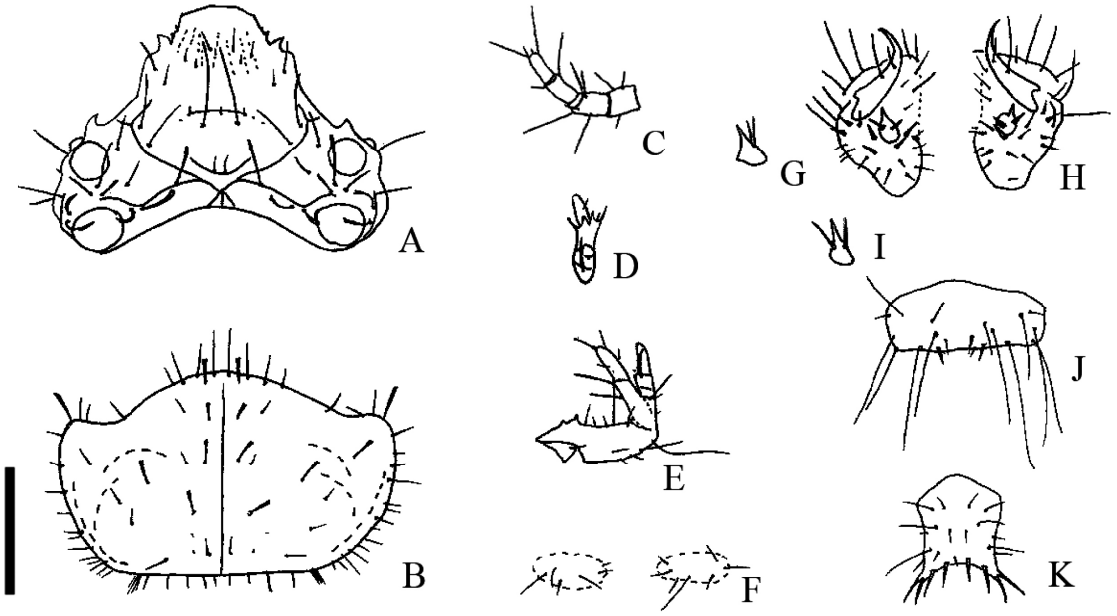


Fig. 7. *Cicindela sauteri*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna(left, dorsal view); D) labium (left part, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

(Fig. 7E) palpi = 1: 2.00: 5.33, galeomere I with two setae on inner margin apically, length ratio of galeae = 1: 0.80.

Pronotum (Fig. 7B): Surface intermixed with nine long bifurcate and five short setae on each half, anterolateral angles rounded, posterior margin straight, at the caudo-lateral angles a cluster of setae (4-5 setae) present.

Abdomen: Tergite III (Fig. 7F) with seven setae; tergite V (Fig. 7H), anterior sclerite with eight setae, lateral sclerite with three setae; posterior sclerite with 17 setae, of which 10 are stout; two pairs of hooks present; median hooks stout with two setae in medium part, inner hooks (Fig. 7G, I) conical with two setae laterally and a distinct spine at middle; posterior margin of tergite IX (Fig. 7J) with four pairs of long and two pairs of short setae; pygopod (Fig. 7K) with 4-5 pairs bristles on caudal margin.

Instar I (n = 1)

Collecting locality:

NANTOU County: Yuchi Township, Lianhuachi, 22 VII 2010.

Measurements: (see Table 2)

Coloration: Head blackish brown with green reflection; mandible and antennae brown; pronotum brown, anterolateral angles light brown; median hooks and inner hooks light brown; setae on head, pronotum and abdomen light brown.

Head (Fig. 8A): U-shaped ridge glabrous; setae around stemma I bifurcate; antennae (Fig. 8C), antennomere I glabrous, antennomere II with two setae; length ratio of antennal segments = 1: 1.29: 1.29: 1.29; length ratio of maxillary (Fig. 8E) palpi = 1: 1.33: 3.33, galeomere I with one seta on inner margin apically, length ratio of galeae = 1: 0.8.

Pronotum (Fig. 8B): Surface intermixed

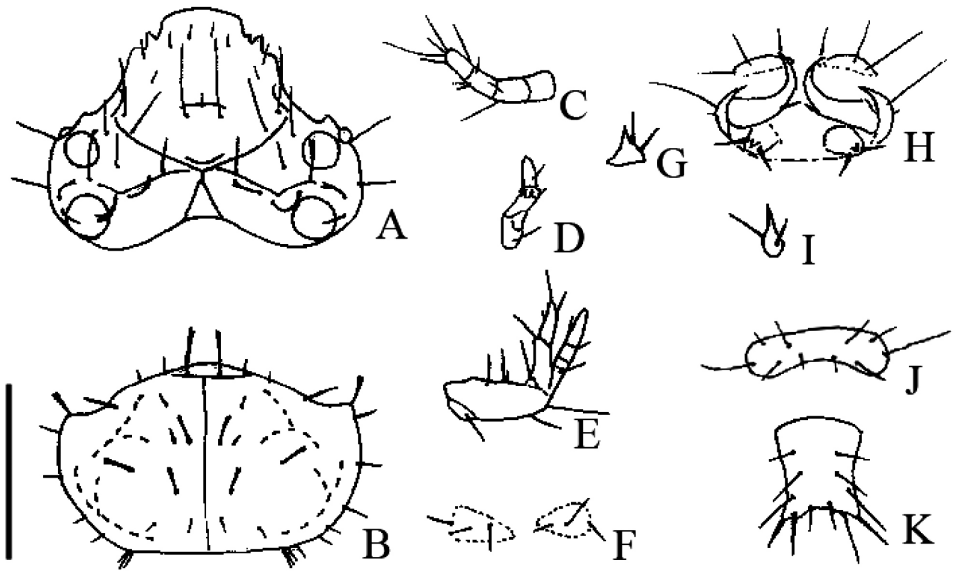


Fig. 8. *Cicindela sauteri*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (left part, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

with five long (of which three bifurcate) and two short setae on each half, marginal setae rare, the caudo-lateral angles a cluster of setae (4-5 setae) presence.
Abdomen: Tergite III (Fig. 8F) with three setae; tergite V (Fig. 8H), anterior sclerite with four setae (one of which is short), lateral sclerite with one seta, posterior sclerite glabrous; two pairs of hooks present, median hooks with one seta in medium part, inner hooks (Fig. 8G, I) conical with two setae laterally and a distinct spine at middle; posterior margin of tergite IX (Fig. 8J) with three pairs of setae; pygopod (Fig. 8K) with three pairs bristles on caudal margin.

Egg (n = 1) (Fig. 9A, B)
Collecting locality:
NANTOU County: Yuchi Township, Lianhuachi, 22 VII 2010.
Measurements:
Figure: Length = 1.20 mm, width = 0.62 mm; chorion white with luster, interior tissues pale brown.

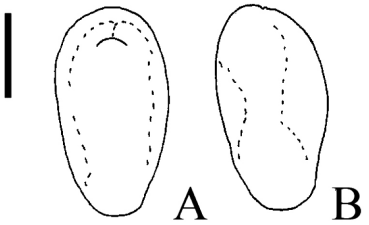


Fig. 9. *Cicindela sauteri*: Egg: A) front view. B) lateral view. [scale bar = 0.5 mm].

Pupa (n = 1) (Fig. 10A, B)
Collecting locality:
Nantou County: Yuchi Township, Sun Moon lake, Shueishe Mountain trail alt. 950 m, 8 III 2003.
Figure: Length = 10.50 mm; head brown with luster; compound eyes gray; antennae

pale yellow; mandible yellow at base, reddish brown apically; pronotum brown, posterior half blackish green; elytra blackish yellow to grayish brown; tergite spurs blackish yellow with apex pale brown; tergites I-V paired dorsal spurs, length of spur IV = 0.40 mm, apex of spurs I-II with 4-6 setae, apex of spurs III-IV with four setae, length of spur V = 1.00 mm, apex of spur V each with a ring arrayed by 9-10 setae.

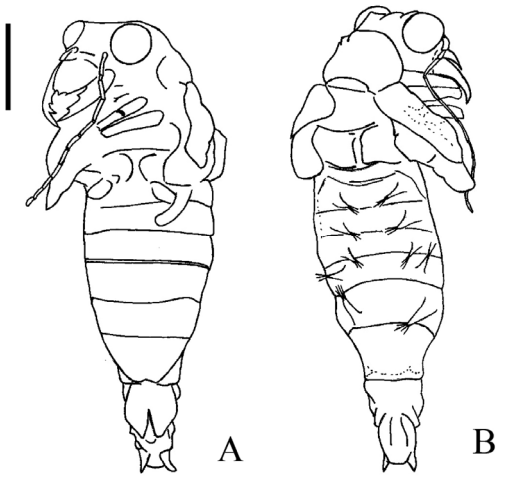


Fig. 10. *Cicindela sauteri*: Pupa: A) ventral view (leg deficient); B) dorsal view (appendage damaged). [scale bar = 2 mm].

Habitat:

The larvae were found mainly on steep slopes covered with mosses, sparsely vegetated hillsides, and eroded areas such as road cuts in hilly regions or at the edge of second growth forests. The entrance to the burrow is usually perpendicular to the face of the slope. The adults are an endemic species and inhabit hills and mountains at elevations from 200-1200 m, but most commonly from 700-1000 m.

***Cylindera* (*Ifasina*) *kaleea* (Bates, 1866)**
姬虎甲蟲

Instar III (n = 5)

Collecting locality:
NANTOU County: Yuchi Township, Sun Moon Lake, Cih-en Tower, 8 III 2003 x 1. CHIAYI City: Chiayi Botanical Garden, 8 XI 2008 x 3. TAICHUNG City: Taichung Metropolitan Park, 1 I 2009 x 1.

Measurements: (see Table 2)

Coloration: Head brown to black; pronotum brown to blackish brown, anterolateral angles and lateral margins pale yellow to brown; mesonotum and metanotum pale brown; antennae brown; mandible brown, blackish distally. Abdomen yellowish, with brown mark; setae light brown to brown.

Head (Fig. 11A): Dorsal surface setae prominent, varying in length; nasale trapezoidal, transverse at apex and several slight longitudinal grooves with tiny setae at base, limited on outer sides by teeth-like produce; clypeus with a row of tiny setae transversely; U-shaped ridge on frons with two setae and separated from ridge on vertex; coronal suture short; antennae (Fig. 11C, D), antennomere I with 5-6 (commonly) setae; antennomere II with 6-7 setae; length ratio of antennal segments = 1: 0.99: 0.78: 0.54; maxillae (Fig. 11F, G), inner margin of stipes with one row of setae and 2-3 spine-like bristles on base, length ratio of maxillary palpi = 1: 2.25: 3.30; galeomere I with three setae on inner margin apically, length ratio of galeae = 1: 0.65; labium (Fig. 11E), basal segment of labial palpi with six bristles at apex.

Pronotum (Fig. 11B): Anterolateral angles produced, extending as far cephalad as the mesal portion, posterior margin of pronotum straight; surface intermixed with 6-7 long and more than 10 short setae on each half, depressions and keels distinct; setae around lateral margins and posterior margin density and slice-like.

Abdomen: Tergite III (Fig. 11H) with 8-12 setae; tergite V (Fig. 11J), anterior sclerites with 7-12 setae, lateral sclerites with four setae, posterior sclerites with 24-29 bristles, of which 18-21 spine-like; two pairs of hooks present, median hooks slender and

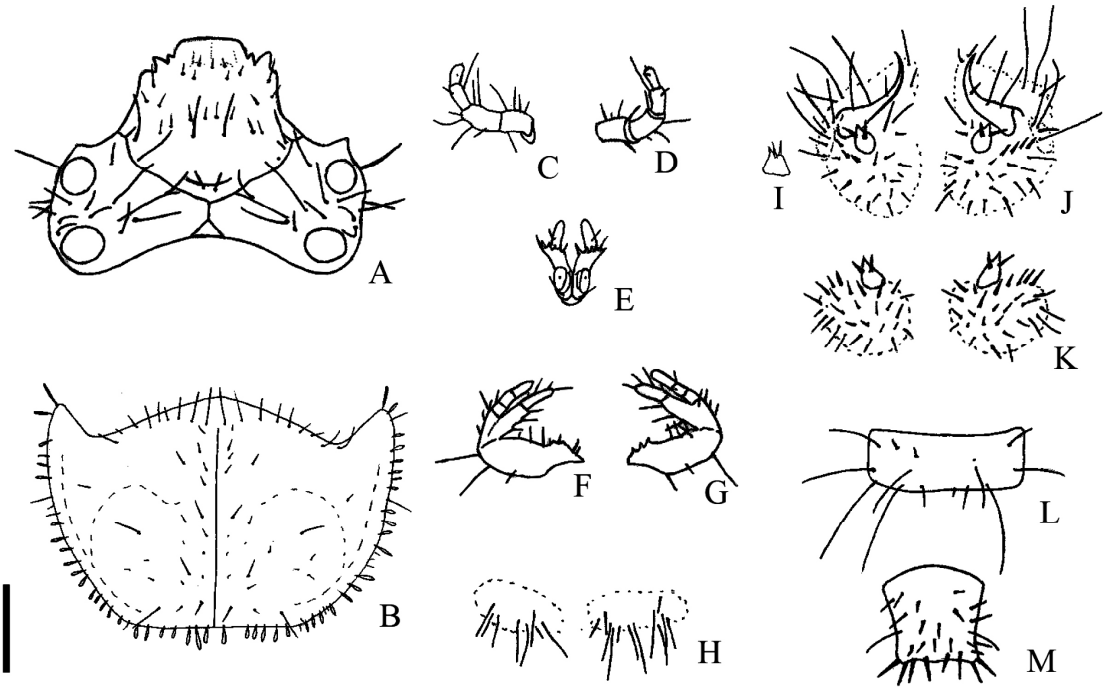


Fig. 11. *Cylindera kaleea*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (right, ventral view); D) antenna (right, dorsal view); E) labium (ventral view); F) maxilla (left, ventral view); G) maxilla (right, ventral view); H) tergite III (dorsal view); I) inner hook (left, lateral view); J) tergite V (dorsal view); K) tergite V (caudal view); L) tergite IX (dorsal view); M) pygopod (dorsal view). [scale bar = 0.5 mm].

arched with three long setae in medium part, upper ones shorter than the other; inner hooks (Fig. 11I) conical with two setae laterally and a small spine at middle; posterior margin of tergite IX (Fig. 11L) with 3-4 pairs of setae, two pairs on middle shortly; pygopod (Fig. 11M) with four pairs bristles on caudal margin.

Instar II (n = 1)
Collecting locality:
NANTOU County: Shuili Township, Yongxing Village, 28 IX 2010.
Measurements: (see Table 2)
Coloration: Head brown with reflection, around stemmata I and II darkened; mandible yellowish brown, apical blackish brown; antennomere I-III light brown, antennomere IV blackish brown; pronotum brown, anterolateral angles pale yellowish; setae on head, pronotum and abdomen light brown.
Head (Fig. 12A): U-shaped ridge on frons with two setae, setae around stemmata I bifurcate; antennae (Fig. 12C), antennomere I with four setae; antennomere II with six setae; length ratio of antennal segments = 1: 1.33: 1.00: 1.11; length ratio of maxillary (Fig. 12E.) palpi = 1: 1.67: 3.00, galeomere I with two setae on inner margin apically, length ratio of galeae = 1: 0.70.
Pronotum (Fig. 12B): Surface intermixed with five long and five short setae on each half, some caudal marginal setae slice-like.
Abdomen: Tergite III (Fig. 12F) with six long and two short setae; tergite V (Fig.

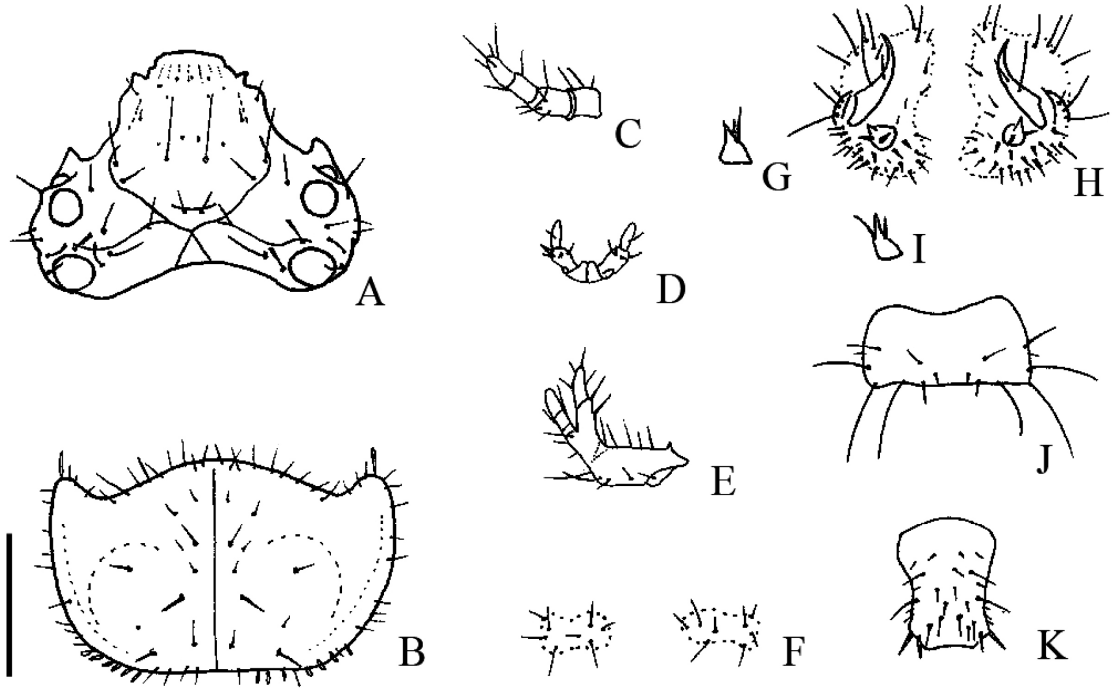


Fig. 12. *Cylindera kaleea*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D)labium (ventral view); E) maxilla (right, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

12H), anterior sclerite with 10 setae, lateral sclerite with three setae, posterior sclerite with 26 bristles, of which 19 thorn-like; two pairs of hooks present, median hooks arched with two setae in medium part; inner hooks (Fig. 12G, I) conical with two setae laterally and a spine at middle; posterior margin of tergite IX (Fig. 12J) with three pairs of setae; pygopod (Fig. 12K) with four pairs bristles on caudal margin.

Instar I (n = 5)
Collecting locality:
NANTOU County: Yuchi Township, Lianhuachi, 16 VII 2010 x 1; Shuili Township, Yongxing Village, 16 VII 2010 x 3, 3 X 2010 x 1.
Measurements: (see Table 2)
Coloration: Head brown with reflection, around stemmata I and II blackish brown; mandible brown, apical blackish brown; pronotum light brown, anterolateral angles more pale; antennae brown, the last one darkened; setae on head, pronotum and abdomen light yellowish brown.
Head (Fig. 13A): U-shaped ridge glabrous, setae around stemmata I bifurcate; antennomere I glabrous; antennomere II with two setae; length ratio of antennal segments = 1: 0.84: 0.98: 1.00; length ratio of maxillary (Fig. 13E) palpi = 1: 1.90: 4.20; galeomere I with 1 seta on inner margin apically; length ratio of galeae = 1: 0.80.
Pronotum (Fig. 13B): Surface intermixed with five long and two short setae on each half, some caudal angles setae slice-like.
Abdomen: Tergite III (Fig. 13F) with three setae; tergite V (Fig. 13H), anterior sclerite with four setae, lateral sclerite with one

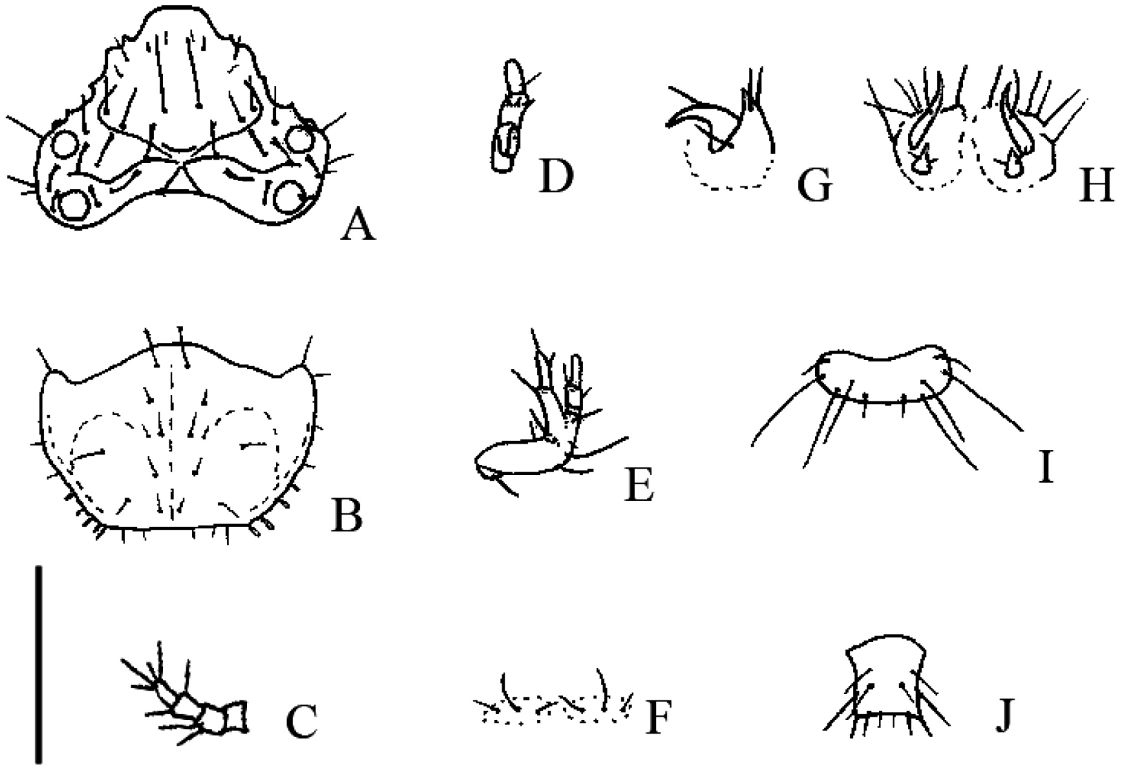


Fig. 13. *Cylindera kaleea*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D)labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (lateral view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.5 mm].

seta, posterior sclerite glabrous; two pairs of hooks present, median hooks arched with one long seta in medium part; inner hooks (Fig. 13G) with two setae laterally and a distinct spine at middle; posterior margin of tergite IX (Fig. 13I) with three pairs of setae; pygopod (Fig. 13J) with three pairs setae on caudal margin.

Egg (n = 2) (Fig. 14)
Collecting locality:
NANTOU County: Shuili Township, Yongxing Village, 16 VII 2010, 4 VIII 2010.
Figure: Length = 0.95-1.15 mm, width = 0.53-0.75 mm; chorion ivory-white with luster.

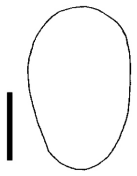


Fig. 14. *Cylindera* (*Ifasina*) *kaleea*: Egg. [scale bar = 0.5 mm].

Pupa (n = 1) (Fig. 15)
Collecting locality:
NANTOU County: Shuili Township, Yongxing Village, 10 V 2011.
Figure: Length = 8.20 mm; compound eyes grayish brown; antennae pale brown;

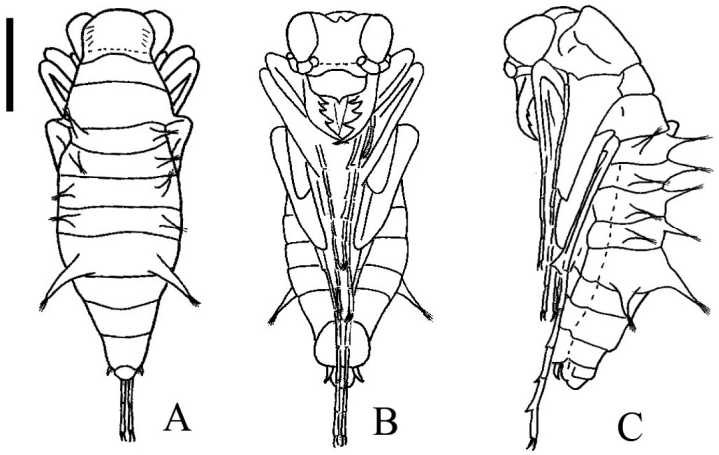


Fig. 15. *Cylindera* (*Ifasina*) *kaleea*: Pupa: A) dorsal view; B) ventral view; C) lateral view. [scale bar = 2 mm].

mandible blackish yellow at base, serration reddish brown; dorsal segments yellow, margin with brown marking; elytra grayish brown; tergite spurs yellow with apex pale brown; setae of spurs pale brown; ventral segments blackish yellow; tergites I-V paired dorsal spurs; length of spur IV = 0.50 mm, apex of spurs I-IV with three setae (mostly); length of spur V = 1.08 mm, apex of spur V each with a ring arrayed by 7-8 setae.

Habitat:

The larvae were found on two sites, one site was bare soil on human-disturbed land with dry hard-packed soil, and the other site was an open area with spare vegetation in which the burrows of the larvae were found among the weeds and grasses. The adults inhabited diverse habitats such as sandy roads, dry ridges in the riverbeds, infrequently used paths and trails, exposed hillsides and eroded flat areas of low and mid-altitude mountains.

Note:

The larvae of *C. kaleea* can be distinguished from other species by their slice-like setae around the lateral and posterior margin of the pronotum.

***Cylindera* (*Eugrapha*) *elisae formosana* (Minowa, 1932)** 小雲紋虎甲蟲

Instar III (n = 6)

Collecting locality:

TAINAN County: Danei Township, Erchongsi Bridge, 16 II 2003 x 2. HUALIEN County: Rueisuei Township, Rueisuei Bridge, 19 II 2003 x 1. CHIAYI County: Yizhu Township, Housheng Bridge, 4 VIII 2010 x 2, 19 VIII 2010 x 1.

Measurements: (see Table 2)

Coloration: Head brown; pronotum light brown with purple reflection; mandible light brown, darker distally; antennae brown; Abdomen yellowish; setae on head and pronotum white but slightly transparent, abdomen setae light brown.

Head (Fig. 16A): Dorsal setae prominent, varying in length; nasale trapezoidal, transverse at apex and slight longitudinal grooves with setae at base, limited on outer sides by teeth-like produce; clypeus with a row of tiny setae transversely and an arc ridge; U-shaped ridge on frons with two setae and separated from ridge on vertex; coronal suture short; antennae (Fig. 16C, D), antennomere I with 5-6 setae; antennomere II with 7-8 setae; length ratio of antennal segments = 1: 1.33: 0.97: 0.72; maxillae (Fig. 16F), stipes inner

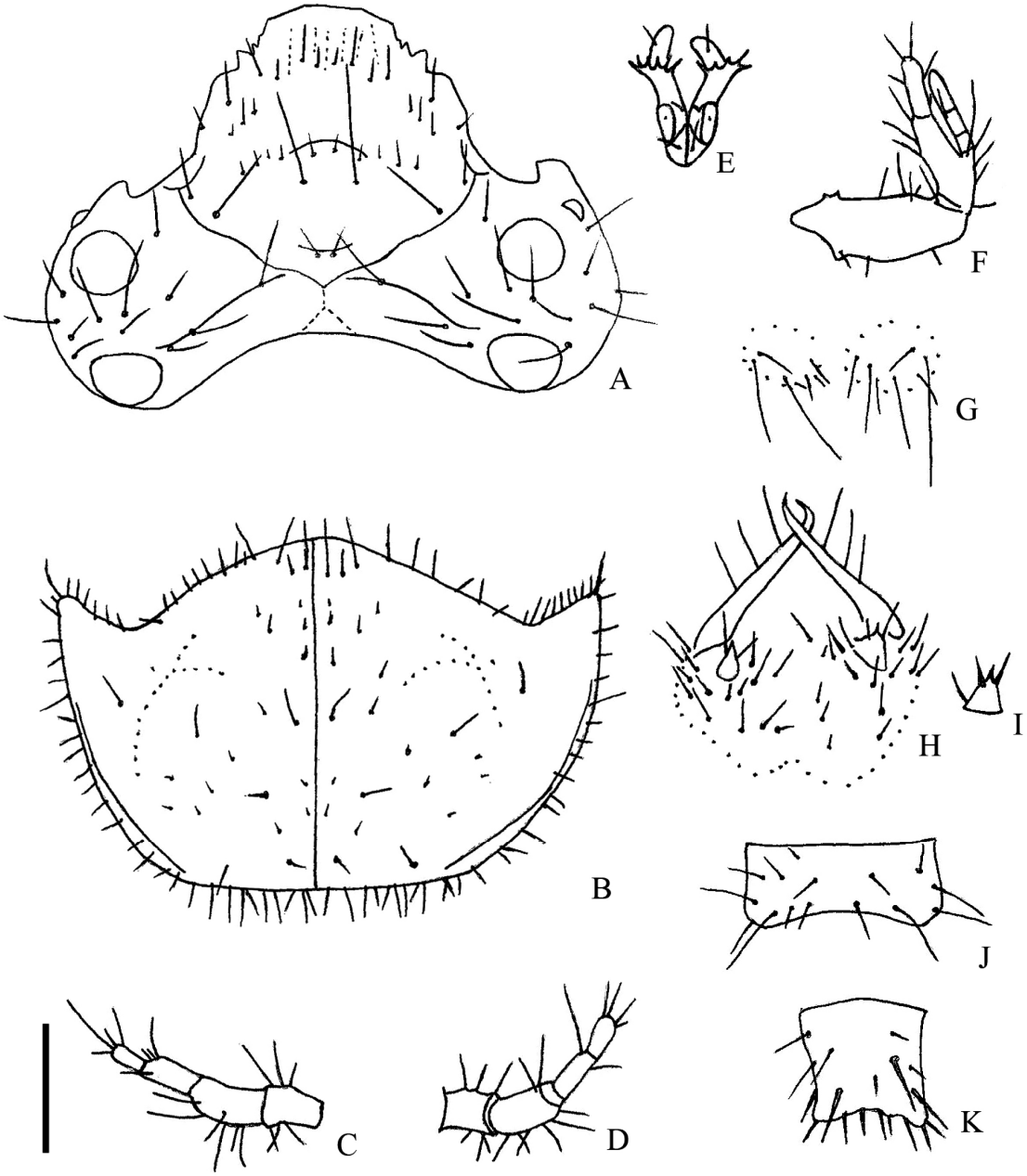


Fig. 16. *Cylindera* (*Eugrapha*) *elisae formosana*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (right, ventral view); D) antenna (right, dorsal view); E) labium (ventral view); F) maxilla (left ventral view); G) tergite III (dorsal view); H) tergite V (dorsal view); I) inner hook (right, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

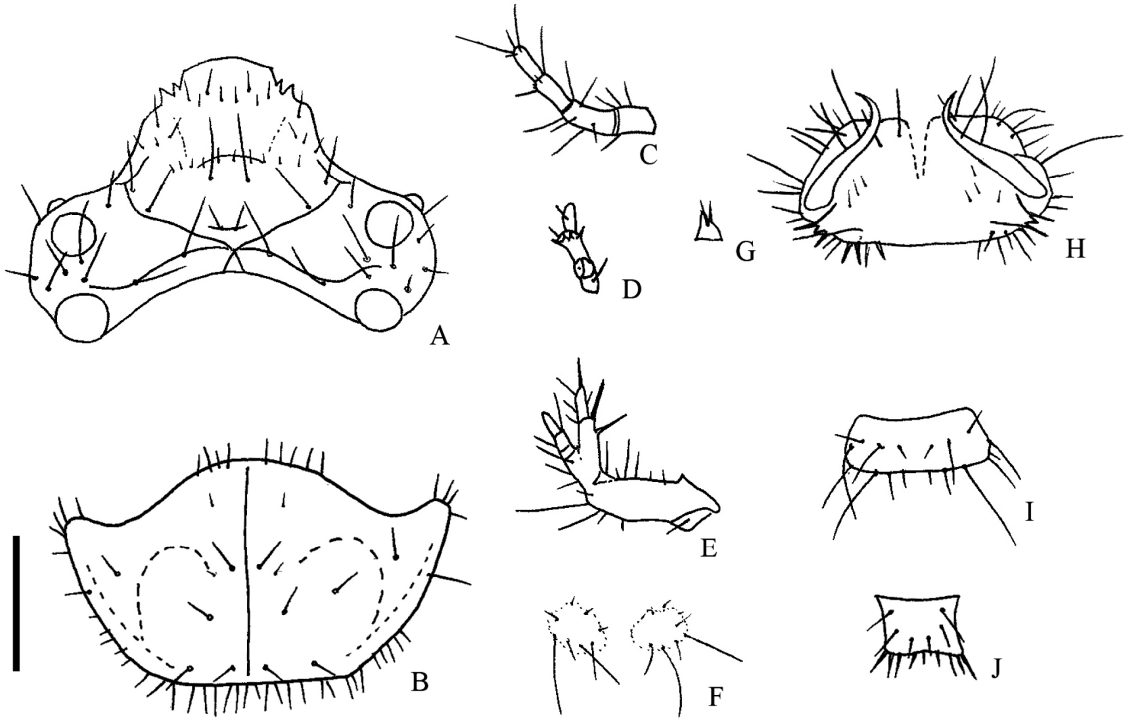


Fig. 17. *Cylindera* (*Eugrapha*) *elisae formosana*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (right, ventral view); E) maxilla (right, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.5 mm].

margin with a row of setae and two teeth-like tuberculae on base; length ratio of maxillary palpi = 1: 1.82: 2.59; galeomere I with three setae on inner margin apically; length ratio of galeae = 1: 0.63; labium (Fig. 16E), basal labial palpomere with six spines at apex.

Pronotum (Fig. 16B): Anterolateral angles produced, lateral margins ridged, posterior margin straight; surface intermixed with 6-7 long and 9-15 short setae on each half; disc depressed distinctly.

Abdomen: Tergite III (Fig. 16G) with 8-9 setae; tergite V (Fig. 16H), anterior sclerites with 15 setae, lateral sclerites with 4-5 setae, posterior sclerite with 21-31 bristles, of which 14-18 spine-like; two pairs of hooks present, median hooks long, slender and arched at apex with three (one side with four occasionally) long setae in medium part; inner hooks (Fig. 16I) with two long setae laterally and one seta at base, a small spine at middle; posterior margin of tergite IX (Fig. 16J) with four pairs of setae, middle two pairs short; pygopod (Fig. 16K) with four pairs of bristles on caudal margin.

Instar II (n = 4)

Collecting locality:

CHIAYI County: Yizhu Township, Housheng Bridge, 4 VIII 2010 x 2, 19 VIII 2010 x 1, 2 XI 2010 x 1.

Measurements: (see Table 2)

Coloration: Head brown to blackish brown with reflection, around stemmata I and II darkened; pronotum brown with luster; mandible basal half yellowish brown and

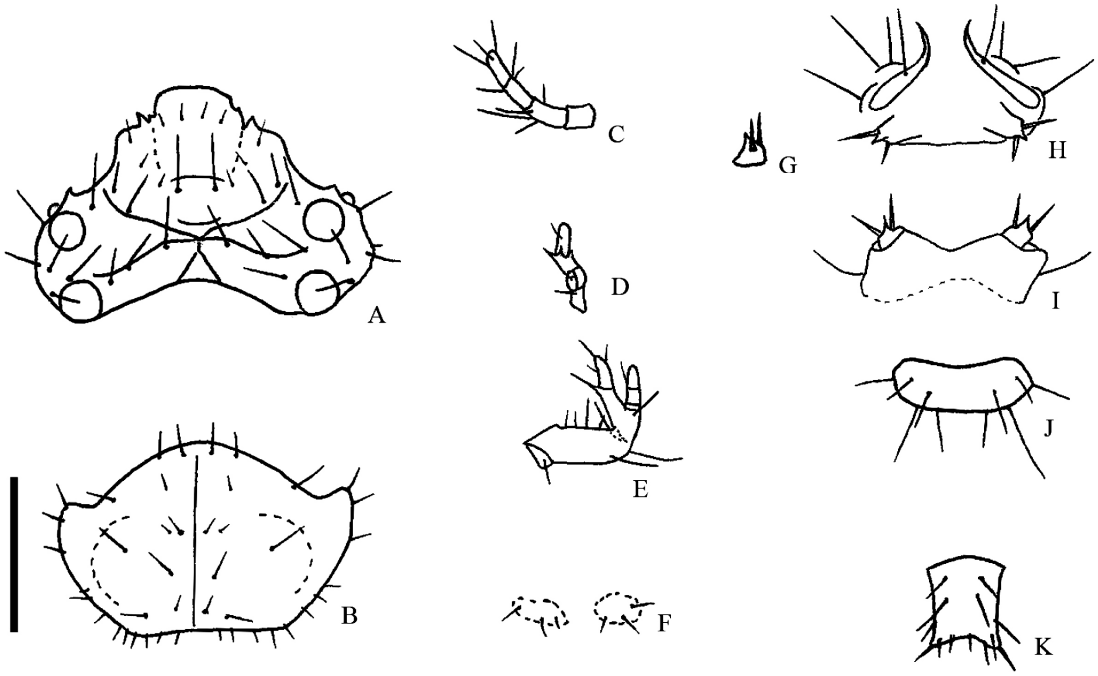


Fig. 18. *Cylindera* (*Eugrapha*) *elisae formosana*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (right, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) tergite V (caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

blackish brown gradually to distal segment; antennae brown at base, blackish brown gradually to distal segment; setae on head and pronotum yellowish white or slightly transparent; setae on abdomen light brown.

Head (Fig. 17A): U-shaped ridge on frons with two setae; antennae (Fig. 17C), antennomere I and II with six setae respectively; length ratio of antennal segments = 1: 1.40: 1.06: 0.97; length ratio of maxillary (Fig. 17E) palpi = 1: 1.54: 3.08; galeomere I with two setae on inner margin apically; length ratio of galeae = 1: 0.67.

Pronotum (Fig. 17B): Surface intermixed with six long and 6-8 short setae on each half.

Abdomen: Tergite III (Fig. 17F) with 7-9 setae; tergite V (Fig. 17H), anterior sclerite with 12-15 setae, lateral sclerite with two long and one short seta, posterior sclerite with 18-21 bristles; two pairs of hooks present, median hooks very long and slender, arched with two long setae in medium part; inner hooks (Fig. 17G) with two setae laterally and a small spine at middle; posterior margin of tergite IX (Fig. 17I) with four pairs of setae; pygopod (Fig. 17J) with nine bristles on caudal margin.

Instar I (n = 5)

Collecting locality:

CHIAYI County: Yizhu Township, Housheng Bridge, 23 VII 2010 x 4, 28 VII 2010 x 1

Measurements: (see Table 2)

Coloration: Head brown with coppery reflection, around stemmata I and II darkened; pronotum brown with luster; mandible basal half yellowish brown and blackish brown gradually to apex; antennae brown at base, blackish brown

gradually to distal segment; setae on body pale yellowish brown.
Head (Fig. 18A): U-shaped ridge on frons glabrous; antennae (Fig. 18C), antennomere I glabrous, antennomere II with three setae; length ratio of antennal segments = 1: 1.31: 1.04: 1.02; length ratio of maxillary (Fig. 18E) palpi = 1: 1.93: 4.77, galeomere I with one seta on inner margin apically; length ratio of galeae = 1: 0.73.
Pronotum (Fig. 18B): Surface intermixed with five long and two short setae on each half.
Abdomen: Tergite III (Fig. 18F) with three setae; tergite V (Fig. 18H), anterior sclerite with four setae, lateral sclerite with one long and one tiny seta, posterior sclerite glabrous; two pairs of hooks present, median hooks very long and slender, arched with one long seta in middle part; inner hooks (Fig. 18I) with two setae laterally and a spine at middle; posterior margin of tergite IX (Fig. 18J) with three pairs of setae; pygopod (Fig. 18K) with three pairs bristles on caudal margin.

Egg (n = 3) (Fig. 19)
Collecting locality:
CHIAYI County: Yizhu Township, Housheng Bridge, 31 V 2010 x 1, 4 VI 2010 x 2.
Figure: Length = 1.60-1.72 mm, width = 0.80-0.88 mm; chorion slightly transparent and with yellowish luster, interior tissues white to yellow.

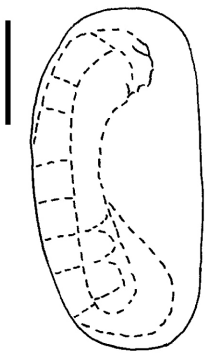


Fig. 19. *Cylindera* (*Eugrapha*) *elisae formosana*: Embryos. (lateral view). [scale bar = 0.5 mm].

Pupa (n = 3) (Fig. 20)
Collecting locality:
CHIAYI County: Yizhu Township, Housheng Bridge, 4 VIII 2010, 6 VIII 2010, 27 IX 2010.
Figure: Length = 7.40-7.70 mm; compound eyes grayish brown; antennae grayish white; mandible blackish yellow at base, serration blackish brown with green luster; dorsal segments blackish yellow, but tergites I-VI with brown marking; elytra blackish yellow; tergite spurs blackish brown, setae on spur pale brown; ventral segments blackish yellow to pale brown; tergites I-V paired dorsal spurs, length of spur IV = 0.60-0.80 mm, apex of spurs I-II with two pairs of setae on opposing positions, apex of spurs III-IV with four setae, length of spur V = 0.88-1.10 mm, apex of spur V each with a ring arrayed by nine (one of them had six) setae.

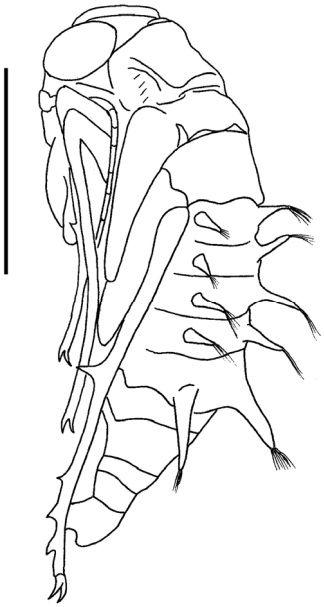


Fig. 20. *Cylindera* (*Eugrapha*) *elisae formosana*: Pupa. [scale bar = 3 mm].

Habitat:
The larvae of *C. e. formosana* were

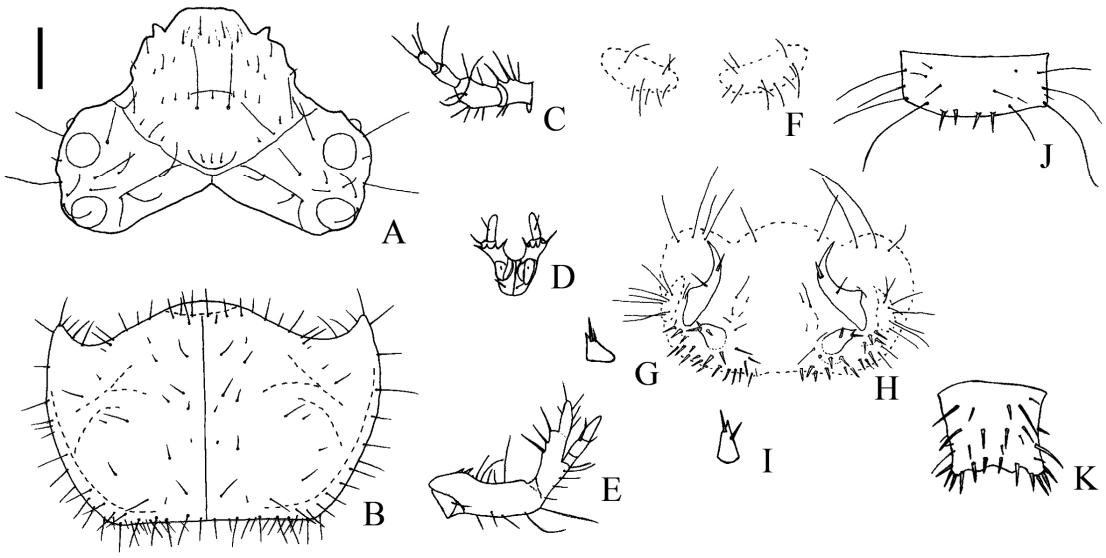


Fig. 21. *Myriochile speculifera*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

found on bare, damp sandy soil near water or in sandy deposits with sparse amounts of vegetation along rivers. The adult is a riparian species, mostly inhabiting sparsely vegetated fine sandy areas along rivers and around ponds adjacent to ocean beaches.

***Myriochile speculifera* (Chevrolat, 1845)**
小鏡斑虎甲蟲
Instar III (n = 2)
Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 1 I 2009, 1 IX 2010.
Measurements: (see Table 2)
Coloration: Head blackish brown; pronotum brown, anterolateral angles and upper half lateral margin of pronotum pale brown; mandible brown at base, otherwise black; antennae brown; abdomen pale brown; setae on body light brown.
Head (Fig. 21A): Dorsal surface setae long and prominent; nasale trapezoidal, transverse at apex with slight longitudinal grooves, limited on outer sides by tooth-like produce; U-shaped ridge on frons with three setae and separated from ridge on vertex; coronal suture obvious; antennae (Fig. 21C), antennomere I with 6-7 setae; antennomere II with 8-9 setae; length ratio of antennal segments = 1: 1.21: 0.90: 0.59; maxillae (Fig. 21E), cardo non-symmetrically triangular with one setae on corner; stipes relatively slender, inner margin with a row of setae and two spine-like bristle on base; length ratio of maxillary palpi = 1: 1.40: 2.20; galeomere I with three setae on inner margin apically; length ratio of galeae = 1: 0.59; labium (Fig. 21D), basal segment of labial palps with five bristles at apex.
Pronotum (Fig. 21B): Anterolateral angles produced, lateral margins carinate with a row of setae, posterior margin of pronotum straight; pronotum surface intermixed with 7-9 long and 5-8 short setae on each half; disc depressed distinctly.
Abdomen: Tergite III (Fig. 21F) with 8-11

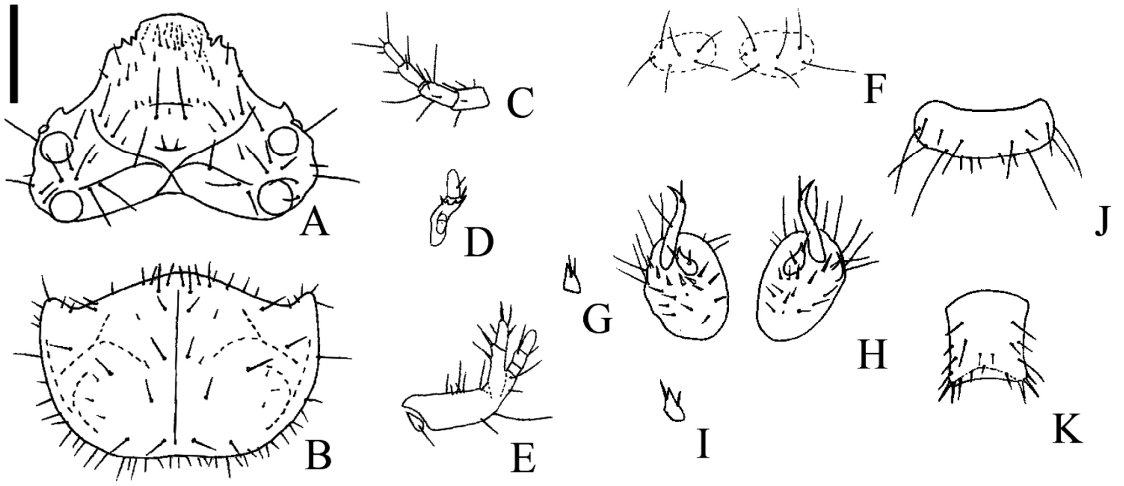


Fig. 22. *Myriochile speculifera*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) inner hook (left, lateral view); H) tergite V (dorsal view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

setae; tergite V (Fig. 21H), anterior sclerite with 6-7 setae, lateral sclerite with 7-8 setae, posterior sclerite with 30-31 bristles (of which 21-23 thorn-like); two pairs of hooks present, median hooks moderate and arched with two short setae, upper ones thorn-like and pointed upward, lower ones fine, if three near to base; inner hooks (Fig. 21G, I) conical with two thorn-like bristles situated asymmetrically, apical spine short and stout; posterior margin of tergite IX (Fig. 21J) with 3-4 pairs of setae, middle 1-2 pairs short and thorn-like; pygopod (Fig. 21K) with 5-6 pairs thorn-like bristles on caudal margin.

Instar II (n = 1)
Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 1 IX 2010.
Measurements: (see Table 2)
Coloration: Head blackish brown with green luster; mandible and antennae rufous; pronotum brown, anterolateral angles light brown; median and inner hooks light brown; abdomen brownish semi- transparent; setae on head brown to transparent, pronotal setae brown, abdominal setae light brown.
Head (Fig. 22A): U-shaped ridge on frons with two setae; antennae (Fig. 22C), antennomere I with four setae, antennomere II with six setae, length ratio of antennal segments = 1: 1.27: 1.00: 0.87; length ratio of maxillary (Fig. 22E) palpi = 1: 1.40: 2.40; galeomere I with two setae on inner margin apically; length ratio of galeae = 1: 0.63.
Pronotum (Fig. 22B): Surface intermixed with seven long and five short setae on each half, lateral margin ridged; disc depressed distinctly.
Abdomen: Tergite III (Fig. 22F) with six setae; tergite V (Fig. 22H), anterior sclerite with five setae, lateral sclerite with three setae, posterior sclerite with 21 bristles (of which 16 thorn-like); two pairs of hooks present, median hooks arched with two setae, upper ones stout; inner hooks (Fig. 22G, I) conical with two setae situated asymmetrically; posterior margin of tergite IX (Fig. 22J) with five pairs of setae,

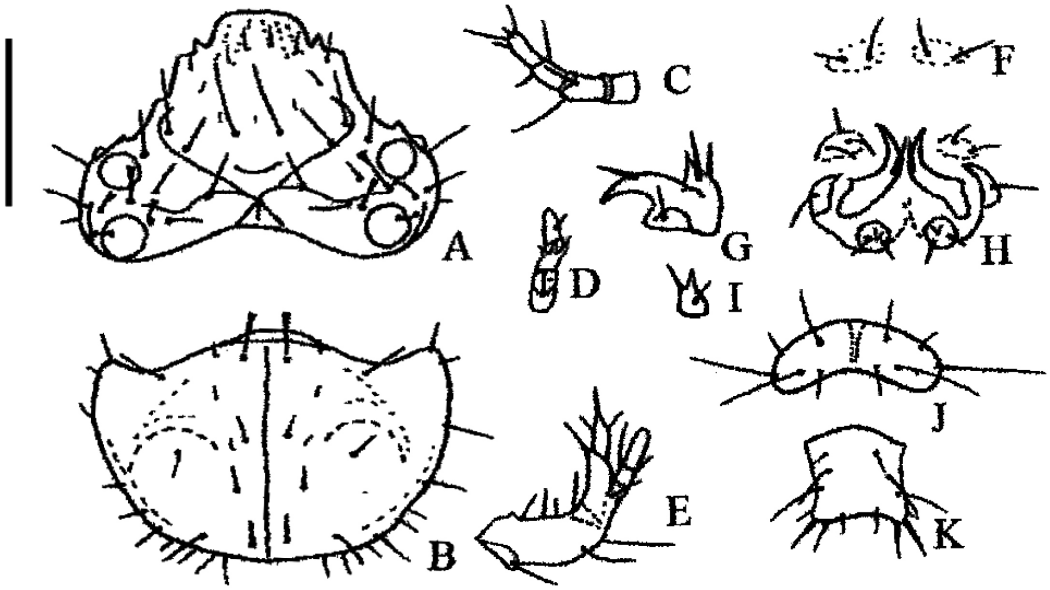


Fig. 23. *Myriochile speculifera*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (left, lateral view); H) tergite V (dorsal view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

middle two pairs short; pygopod (Fig. 22K) with four pairs bristles on caudal margin.

Instar I (n = 2)
Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 5 VII 2010, 5 VIII 2010.
Measurements: (see Table 2)
Coloration: Head brown with green luster; mandible and antennae yellowish brown; pronotum light brown; median and inner hooks pale light brown; abdomen semi-transparent; setae of head and pronotum brown, abdominal setae light brown.
Head (Fig. 23A): U-shaped ridge on frons glabrous; antennae (Fig. 23C), antennomere I glabrous, antennomere II with two setae; length ratio of antennal segments = 1: 1.50: 1.25: 1.25; length ratio of maxillary palpi = 1: 1.75: 3.50; galeomere I with one seta on inner margin apically; length ratio of galeae = 1: 0.71.
Pronotum (Fig. 23B): Surface intermixed with five long and two short setae on each half, anterior margin with one pair of long and flattened apex setae near midline.
Abdomen: Tergite III (Fig. 23H) with 2-3 setae; tergite V (Fig. 23G), anterior sclerite with three setae, lateral sclerite with one seta, posterior sclerite glabrous; two pairs of hooks present, median hooks arched with one seta; inner hooks (Fig. 23I) conical with two bristles situated asymmetrically; posterior margin of tergite IX (Fig. 23J) with three pairs of setae, the middle short; pygopod (Fig. 23K) with three pairs bristles on caudal margin.

Egg (n = 1) (Fig. 24)
Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 1 VI 2010.
Figure: Length = 1.62 mm, width = 0.91 mm; chorion yellowish.

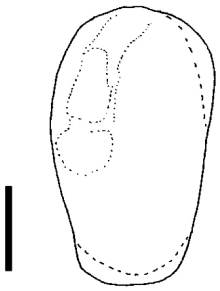


Fig. 24. *Myriochile speculifera*: Egg. [scale bar = 0.5 mm].

Pupa (n = 1) (Fig. 25)
Collecting locality:
CHIAYI County: Puzi Township, Dongshi High school 3 VI 2011.
Figure: Length = 11.40 mm; compound eyes pale brown; mandible brown, distal and serration black; dorsal segments blackish yellow; elytra brown, spurs IV and V blackish brown; ventral segments blackish yellow; tergites I-V paired dorsal spurs, length of spur IV = 1.00 mm, apex of spurs I-II with 3-4 setae, apex of spurs III-IV with four setae, length of spur V = 2.25 mm, apex of spur V each with 9-10 setae.

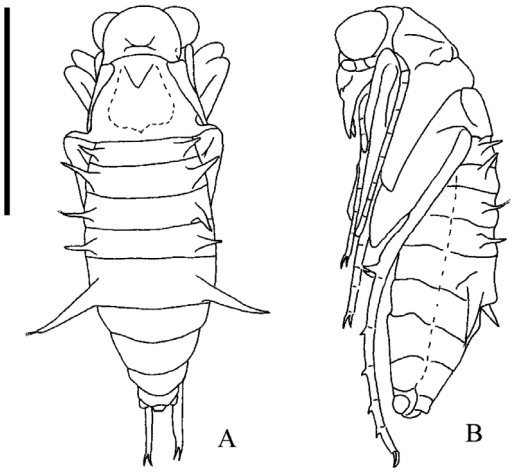


Fig. 25 *Myriochile speculifera*: Pupa: A) dorsal view; B) lateral view. [scale bar = 6 mm].

Habitat:
The larvae were found on red-clay terraces, bare or with sparse vegetation. The adults were found in a variety of habitats, open paths and trails or bare spots in grasslands, in the moist sandy or gravel flats of creeks or stream mouths close to the beach, and in dry red-clay cultured areas.
Note:
The larvae of *C. speculifera* can be distinguished from other species by two thorn-like bristles situated asymmetrically on the inner hooks.

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The author is grateful to Dr. Shi-Kuei Wu, Professor Emeritus, University of Colorado at Boulder, for providing some helpful references; and to Dr. Fabio Cassola of Rome, Italy for his useful suggestion. Thanks also to Dr. Ching-Yu Liou and Dr. Jen-Zon Ho at the Taiwan Endemic Species Research Institute for their encouragement and support. Many thanks to Ming-shiang Jiang and the two reviewers for amending the first draft.

References

Arndt E, Paarmann W, Adis J. 1996. Description and key of larval Cicindelidae from Brazil (Coleoptera: Caraboidea). Acta Soc Zool Bohemoslov 60: 293-315.

Hamilton CC. 1925. Studies on the morphology, taxonomy, and ecology of the larvae of Holarctic tiger beetles (Family Cicindelidae). Proc US Nat Mus 65: 1-87.

Knisley CB, Pearson DL. 1984. Biosystematics of larval tiger beetles of the Sulphur Springs Valley, Arizona. Trans Am Entomol Soc 110: 465-551.

Knisley CB, Schultz TD. 1997. The biology of tiger beetles and a guide to the species of the South Atlantic States. Virginia Museum of Natural History.

p23.

Pearson DL, Cassola F. 2005. A quantitative analysis of species descriptions of tiger beeltles (Coleoptera: Cicindelidae), from 1758 to 2004, and notes about related developments in biodiversity studies. The Coleopterists Bulletin 59 (2): 184-193.

Putchkov A, Wu IH, Lee CF. 2008 Larval description of the tiger beetles *Cosmodela batesi* (Fleutiaux, 1893) (Carabidae: Cicindelinae). The Coleopterists Bulletin 62 (2): 197-201.

Putchkov AV, Cassola F. 1994. The larvae of tiger beetles from Central Asia (Coleoptera: Cicindelidae). Bollettino del Museo Civico di Storia Naturale di Verona 18: 11-43.

Rivalier E. 1971. Remarques sur la tribu des Cicindelini (Col. Cicindelidae) et sa subdivision en sous-tribus. Nouv Rev Entomol 1: 135-143.

Werner K, Chen KM, Yang MM. 2002. Contribution to the knowledge of the tiger beetles of Taiwan with notes to the species of Lanyu (Coleoptera: Cicindelidae). Collection and Research 15: 35-52.

Wiesner J. 1992. Verzeichnis der Sandlaufkafer der Welt. (checklist of the tiger beetles of the world). Keltern Germany: Verlag Erna Bauer.

Wu IH, Ho CH, Hsiao CI, Yang PS. 2006. Morphology and life history of the tiger beetle *Cicindela batesi* (Fleutiaux, 1893). Taipei Zoo Bulletin 18: 7-14.

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Appendix 1. Coordinates of the collecting sites for the 3rd instar larvae and adult tiger beetle

Species	Collecting sites
C. angulata	Chiayi County: Yizhu Township, Housheng Bridge (23°19'45", 120°15'10"). Hualien County: Ji-an Township, Hualien Bridge (23°55'23", 121°35'47"); Rueisuei Township, Cimei (23°29'25", 121°26'51"); Rueisuei Bridge (23°29'13", 121°24'63"); Yuli Township, Yuli Bridge (23°19'34", 121°19'42"). Pingtung County: Ligang Township, Liling Bridge (22°46'11", 120°27'15").
C. sauteri	Nantou County: Yuchi Township, Sun Moon lake, Shueishe Mountain trail alt. 950 m (23°50'40", 120°56'20"); Yuchi Township, Lianhuachi (23°55'03", 120°53'04").
C. kaleea	TaichunG City: Taichung Metropolitan Park (24°12'14", 120°36'03"). NANTOU County: Yuchi Township, Sun Moon Lake, Cih-en Tower (23 50' 30", 120 55' 16"); Lianhuachi (23°50'30", 120°55'16"); Shuili Township, Yongxing Village (23°47'14", 120°51'05"). CHIAYI City: Chiayi Botanical Garden (23°29'02", 120°28'04").
C. elisae formosana	Chiayi County: Yizhu Township, Housheng Bridge (23°19'45", 120°15'10"). Hualien County: Rueisuei Township, Rueisuei Bridge (23°29'13", 121°24'63"). Tainan County: Danei Township, Erchongsi Bridge (23°06'55", 120°22'58").
M. speculifera	Taichung City: Taichung Metropolitan Park (24°12'23", 120°36'09"); (24°12'12", 120°35'58").

台灣產虎甲蟲幼生期描述 (I)

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摘　　要

描述台灣產 5 種虎甲蟲的完整幼生期，包括卵、1 齡、2 齡、終齡及蛹，並簡述幼蟲棲地。這 5 種虎甲蟲分別是：雲紋凸緣虎甲蟲 *Calomera angulata* (Fabricius, 1798)、梭德氏虎甲蟲 *Cicindela* (*Cylindera*) *sauteri* (Horn, 1912)、姬虎甲蟲 *Cylindera* (*Ifasina*) *kaleea* (Bates, 1866)、小雲紋虎甲蟲 *Cylindera* (*Eugrapha*) *elisae formosana* (Minowa, 1932) 及小鏡斑虎甲蟲 *Myriochile speculifera* (Chevrolat, 1845)。

關鍵詞：虎甲蟲科、幼生形態、棲地、台灣。

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