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Description of the Immatures of the Tiger Beetles (Coleoptera: Cicindelidae) from Taiwan (II)【Research report】

台灣產虎甲蟲幼生期描述 (II)【研究報告】

Tzong-Jeng Lin
林宗政

*通訊作者E-mail : lllinnn@tesri.gov.tw

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Abstract

The immatures of seven cicindelid species and subspecies in Taiwan and its adjacent islets are reported. Descriptions of the complete immature stages, from egg to pupa, are provided for Lophyra cancellata subtilesculpta, Cylindera psilica and Cylindera elisae reductelineata; all but the description of the egg are provided for Abroscelis anchoralis anchoralis and Abroscelis anchoralis punctatissima; all but the pupal stage are provided for Therates alboobliquatus alboobliquatus and Lophyra striolata dorsolineolata. Illustrations, habitat and brief notes are also provided.

摘要

描述台灣產7種虎甲蟲的幼生期，其中多斑虎甲蟲Lophyra cancellata subtilesculpta、小八星虎甲蟲Cylindera psilica與暗紋虎甲蟲Cylindera elisae reductelineata等3種有包含卵、幼蟲至蛹的完整描述，Abroscelis anchoralis anchoralis及錨紋虎甲蟲Abroscelis anchoralis punctatissima則描述除了卵之外的幼生期各階段，而斜紋突眼虎甲蟲Therates alboobliquatus alboobliquatus與縱紋虎甲蟲Lophyra striolata dorsolineolata則為卵至3齡幼蟲的描述。除此，並附上幼蟲棲地與成蟲生態的簡短資料。

Key words: Cicindelidae, tiger beetle, larval morphology, taxonomy, Taiwan

關鍵詞: 虎甲蟲科、虎甲蟲、幼蟲形態、分類、台灣。

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

Tzong-Jeng Lin

Taiwan Endemic Species Research Institute, No. 1 Min-Sheng East Road, JiJi, Nantou County 55244, Taiwan

ABSTRACT

The immatures of seven cicindelid species and subspecies in Taiwan and its adjacent islets are reported. Descriptions of the complete immature stages, from egg to pupa, are provided for *Lophyra cancellata subtilesculpta*, *Cylindera psilica* and *Cylindera elisae reductelineata*; all but the description of the egg are provided for *Abroscelis anchoralis anchoralis* and *Abroscelis anchoralis punctatissima*; all but the pupal stage are provided for *Therates alboobliquatus alboobliquatus* and *Lophyra striolata dorsolineolata*. Illustrations, habitat and brief notes are also provided.

Key words: Cicindelidae, tiger beetle, larval morphology, taxonomy, Taiwan

Introduction

More than 2,600 species of Cicindelidae are recorded (Pearson and Cassola, 2005). About 30 species of Cicindelidae have been recorded in Taiwan (Werner *et al*., 2002). Despite the considerable knowledge of the adults of these species, little has been published about the larvae of the tiger beetles in the Oriental groups (Arndt and Cassola, 2000). Until now, only 6 species of tiger beetle larvae of Taiwan have been described, including *Calomera angulata* (Fabricius, 1798), *Cosmodela batesi* (Fleutiaux, 1893), *Cicindela sauteri* (Horn, 1912), *Cylindera kaleea* (Bates, 1866), *Cy. elisae formosana* (Minowa, 1932) and *Myriochile speculifera* (Chevrolat, 1845) (Putchkov *et al*., 2008, Lin, 2012). This paper further extends the knowledge on tiger beetle larvae by presenting immatures of the other seven tiger beetle species in Taiwan.

Materials and Methods

The series of larvae specimens used were from the author's collections, including ex ovum larvae reared in the laboratory and larvae collected in the field during 2002-2004 and 2009-2013 (cf. Table 1). All specimens were preserved in a 75% ethanol solution.

A stereomicroscope (WILD MZ8) aided by an eyepiece graticule was employed for all measurements and illustrations. The

*Corresponding email: llliinnn@tesri.gov.tw

Table 1. Sources of larval and pupal specimens

Stage	3rd instar larvae[1]	2nd instar larvae[1]	1st instar larvae[1]	Pupae[2]
Therates alboobliquatus alboobliquatus	R	F	R	-
Lophyra cancellata subtilesculpta	F, R	R	R	LR
Lophyra striolata dorsolineolata	F, R	R	R	-
Cylindera psilica	R	R	R	LR
Cylindera elisae reductelineata	F, R	R	R	LF, LR
Abroscelis anchoralis anchoralis	F	F	F	LF
Abroscelis anchoralis punctatissima	F	F	F	LF

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

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

measurements of the first-, second-, and third-instar of larvae are shown in Table 2. The larvae were identified either ex ovum from parent females collected in the field, or by rearing field collected larvae to the adult stage. The nomenclature follows Rivalier (1971), Wiesner (1992) and Werner *et al*. (2002). The morphological terminology follows Hamilton (1925), Knisley and Pearson (1984) and Putchkov and Cassola (1994).

Descriptions

All three instars of larvae described here share the following characters: dorsal surface setae of head prominent, ranging from long to short; nasale trapezoidal, transverse at apex with several slight longitudinal grooves (first instar excluded) with tiny setae at base, limited on outer sides by produced teeth; clypeus with a row of transverse tiny setae; U-shaped ridge on frons separated from ridge on vertex; coronal suture short or unclear; palpiger area divided by distinct sclerite; distal segment of labial palpi with a single seta in the middle; gular suture T-shaped. First instar with additional characters as follows: U-shaped ridge on frons glabrous; antennomere I glabrous; galeomere I with one apical seta on inner margin; posterior sclerites of tergite V glabrous.

***Therates alboobliquatus alboobliquatus* Horn, 1909** 斜紋突眼虎甲蟲

Instar III (n = 1)

Collecting locality:

MIAOLI County: Nanzhuang Township, Jiali Mt., 2010.

Coloration: Head reddish brown, around stemmata I and II black; antennae pale brown; mandible reddish brown, apical half dark brown; pronotum dark brown, lateral margins reddish brown, caudal margin deep yellow; setae of body light brown.

Head (Fig. 1A): Nasale somewhat narrow, apical half descents ladder-like; U-shaped ridge on frons with three setae; antennae (Fig. 1C), antennomere I with 3 setae, antennomere II with 6 setae, length ratio of antennal segments = 1.00 : 0.81 : 0.73 : 0.46; maxillae (Fig. 1E), inner margin of stipes with several setae and 2 shallow protuberances on base, length ratio of maxillary palpomeres = 1.00 : 1.29 : 2.43, galeomere I with 3 apical setae on inner margin, length ratio of galeae = 1.00 : 0.53; labium (Fig. 1D), basal segment of labial palpi with 5 setae at apex, central 3 setae short spine-like.

Pronotum (Fig. 1B): Anterior margin relatively even, posterior margin slightly curved; surface intermixed with 7 long and more than 30 short setae on each half, setae on lateral margins sparse, caudolateral angles with a cluster of setae,

Table 2. Measurements of larval specimens*

Character	Instar	*T. a. alboobliquatus*	*L. c. subtilesculpta*	*L. s. dorsolineolata*	*Cy. psilica*
Width of head	III	2.18	2.73 ± 0.10	2.98 ± 0.19	1.83 ± 0.03
	II	1.90	1.76 ± 0.02	1.80	1.21 ± 0.01
	I	0.74	1.13 ± 0.05	1.19 ± 0.08	0.75 ± 0.02
Width of pronotum	III	2.23	2.69 ± 0.17	3.18 ± 0.20	1.93 ± 0.06
	II	1.90	1.65 ± 0.00	1.93	1.27 ± 0.01
	I	0.68	1.06 ± 0.03	1.12 ± 0.14	0.72 ± 0.03
Length of pronotum	III	1.25	1.73 ± 0.06	2.01 ± 0.19	1.22 ± 0.04
	II	1.04	1.13 ± 0.00	1.21	0.80 ± 0.02
	I	0.40	0.71 ± 0.03	0.68 ± 0.10	0.44 ± 0.04
Length of antennomere I	III	0.26	0.39 ± 0.03	0.34 ± 0.05	0.24 ± 0.02
	II	0.26	0.22 ± 0.00	0.15	0.14 ± 0.00
	I	0.08	0.14 ± 0.01	0.10 ± 0.00	0.08 ± 0.00
Length of antennomere II	III	0.21	0.43 ± 0.05	0.34 ± 0.02	0.23 ± 0.01
	II	0.22	0.21 ± 0.01	0.21	0.14 ± 0.00
	I	0.06	0.13 ± 0.01	0.10 ± 0.00	0.08 ± 0.00
Length of antennomere III	III	0.19	0.27 ± 0.02	0.26 ± 0.03	0.15 ± 0.03
	II	0.19	0.19 ± 0.01	0.18	0.11 ± 0.01
	I	0.07	0.11 ± 0.01	0.10 ± 0.00	0.06 ± 0.01
Length of antennomere IV	III	0.12	0.22 ± 0.00	0.24 ± 0.04	0.12 ± 0.03
	II	0.12	0.16 ± 0.01	0.16	0.09 ± 0.01
	I	0.08	0.11 ± 0.01	0.15 ± 0.01	0.07 ± 0.01
Length of maxillary palpomere I	III	0.07	0.07 ± 0.01	0.09 ± 0.01	0.04 ± 0.00
	II	0.08	0.06 ± 0.01	0.04	0.03 ± 0.00
	I	0.03	0.03 ± 0.01	0.03 ± 0.00	0.03 ± 0.00
Length of maxillary palpomere II	III	0.09	0.15 ± 0.01	0.15 ± 0.02	0.09 ± 0.01
	II	0.12	0.10 ± 0.00	0.10	0.06 ± 0.00
	I	0.04	0.06 ± 0.00	0.05 ± 0.01	0.03 ± 0.00
Length of maxillary palpomere III	III	0.17	0.21 ± 0.01	0.20 ± 0.02	0.14 ± 0.01
	II	0.16	0.17 ± 0.01	0.15	0.11 ± 0.01
	I	0.08	0.13 ± 0.01	0.14 ± 0.02	0.09 ± 0.01
Length of galeomere I	III	0.30	0.52 ± 0.02	0.48 ± 0.03	0.33 ± 0.03
	II	0.26	0.34 ± 0.00	0.28	0.20 ± 0.01
	I	0.11	0.21 ± 0.01	0.19 ± 0.01	0.14 ± 0.02
Length of galeomere II	III	0.16	0.32 ± 0.02	0.29 ± 0.01	0.15 ± 0.04
	II	0.19	0.21 ± 0.01	0.18	0.14 ± 0.01
	I	0.07	0.14 ± 0.01	0.12 ± 0.02	0.09 ± 0.01
Length of the inner hook central spine	III	0.09	0.07 ± 0.01	0.08 ± 0.00	0.05 ± 0.01
	II	0.08	0.06 ± 0.00	0.08	0.05 ± 0.01
	I	0.04	0.07 ± 0.01	0.08 ± 0.00	0.05 ± 0.01
Entire length of the inner hooks	III	0.14	0.21 ± 0.03	0.25 ± 0.02	0.15 ± 0.03
	II	0.14	0.17 ± 0.00	0.24	0.11 ± 0.01
	I	0.07	0.13 ± 0.01	0.14 ± 0.02	0.09 ± 0.01
Length of the inner hook setae	III	0.08	0.30 ± 0.00	0.16 ± 0.04	0.12 ± 0.03
	II	0.08	0.21 ± 0.01	0.18	0.11 ± 0.01
	I	0.04	0.16 ± 0.03	0.12 ± 0.02	0.09 ± 0.01

Table 2. (continued)

Character	Instar	*Cy. e. reductelineata*	*A. a. anchoralis*	*A. a. punctatissima*
Width of head	III	2.22 ± 0.13	2.95 ± 0.16	2.65 ± 0.15
	II	1.37 ± 0.00	2.01 ± 0.18	1.74 ± 0.19
	I	0.98 ± 0.03	1.45 ± 0.06	1.34 ± 0.03
Width of pronotum	III	2.20 ± 0.14	2.73 ± 0.19	2.45 ± 0.14
	II	1.31 ± 0.00	1.80 ± 0.16	1.53 ± 0.18
	I	0.92 ± 0.04	1.25 ± 0.14	1.18 ± 0.03
Length of pronotum	III	1.40 ± 0.09	1.84 ± 0.12	1.53 ± 0.08
	II	0.85 ± 0.00	1.21 ± 0.07	1.13 ± 0.09
	I	0.62 ± 0.01	0.83 ± 0.10	0.79 ± 0.06
Length of antennomere	III	0.28 ± 0.02	0.41 ± 0.04	0.35 ± 0. 08
I	II	0.17 ± 0.04	0.26 ± 0.01	0.26 ± 0.02
	I	0.12 ± 0.00	0.15 ± 0.01	0.16 ± 0.01
Length of antennomere	III	0.29 ± 0.03	0.47 ± 0.03	0.40 ± 0.02
II	II	0.17 ± 0.03	0.31 ± 0.02	0.28 ± 0.03
	I	0.12 ± 0.01	0.20 ± 0.03	0.19 ± 0.01
Length of antennomere	III	0.21 ± 0.01	0.27 ± 0.03	0.22 ± 0.01
III	II	0.13 ± 0.01	0.19 ± 0.01	0.18 ± 0.03
	I	0.10 ± 0.01	0.14 ± 0.00	0.13 ± 0.01
Length of antennomere	III	0.14 ± 0.02	0.19 ± 0.04	0.15 ± 0.02
IV	II	0.12 ± 0.01	0.14 ± 0.02	0.13 ± 0.02
	I	0.10 ± 0.00	0.11 ± 0.01	0.11 ± 0.01
Length of maxillary	III	0.06 ± 0.02	0.09 ± 0.01	0.08 ± 0.01
palpomere I	II	0.04 ± 0.00	0.05 ± 0.01	0.04 ± 0.01
	I	0.02 ± 0.00	0.04 ± 0.00	0.03 ± 0.00
Length of maxillary	III	0.11 ± 0.02	0.13 ± 0.02	0.11 ± 0.02
palpomere II	II	0.07 ± 0.01	0.09 ± 0.02	0.09 ± 0.01
	I	0.04 ± 0.00	0.07 ± 0.01	0.06 ± 0.01
Length of maxillary	III	0.15 ± 0.02	0.16 ± 0.03	0.13 ± 0.01
palpomere III	II	0.12 ± 0.00	0.13 ± 0.01	0.12 ± 0.01
	I	0.10 ± 0.01	0.13 ± 0.01	0.12 ± 0.01
Length of galeomere I	III	0.41 ± 0.03	0.67 ± 0.06	0.58 ± 0.04
	II	0.24 ± 0.01	0.44 ± 0.03	0.42 ± 0.03
	I	0.17 ± 0.01	0.28 ± 0.02	0.26 ± 0.02
Length of galeomere II	III	0.25 ± 0.02	0.33 ± 0.04	0.28 ± 0.03
	II	0.16 ± 0.00	0.23 ± 0.03	0.24 ± 0.01
	I	0.12 ± 0.00	0.19 ± 0.01	0.15 ± 0.01
Length of the inner	III	0.02 ± 0.01	0.06 ± 0.01	0.05 ± 0.02
hook central spine	II	0.02 ± 0.00	0.07 ± 0.02	0.06 ± 0.02
	I	0.05 ± 0.01	0.07 ± 0.01	0.06 ± 0.01
Entire length of the	III	0.11 ± 0.02	0.22 ± 0.05	0.17 ± 0.05
inner hooks	II	0.09 ± 0.00	0.21 ± 0.03	0.18 ± 0.04
	I	0.09 ± 0.01	0.17 ± 0.01	0.16 ± 0.01
Length of the inner	III	0.16 ± 0.03	0.36 ± 0.07	0.36 ± 0.03
hook setae	II	0.12 ± 0.01	0.28 ± 0.03	0.27 ± 0.03
	I	0.13 ± 0.01	0.27 ± 0.01	0.22 ± 0.03

*All the numerical unit = mm.

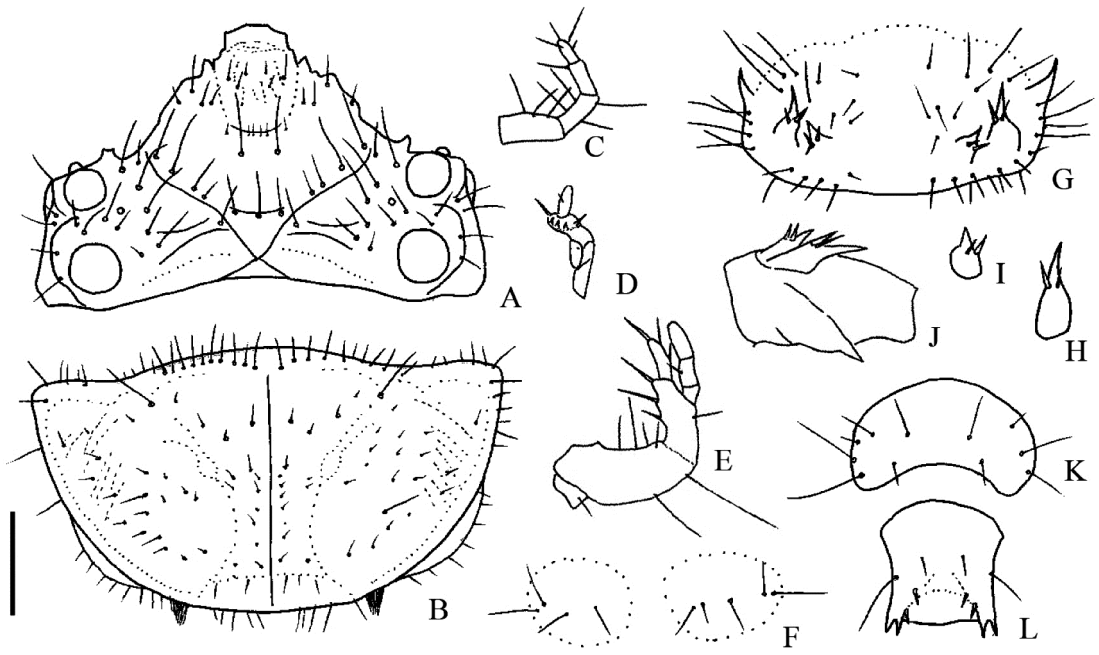

Fig. 1. *Therates alboobliquatus alboobliquatus*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (right, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) median hook (right, caudal view); I) inner hook (right, caudal view); J) tergite V (right, lateral view); K) tergite IX (dorsal view); L) pygopod (dorsal view). [scale bar: A, B, C, F, G, K, L = 0.5 mm, D, E, H, I, J = 0.4 mm].

depression distinct.

Abdomen: Tergite III (Fig. 1F) with 4-5 setae; tergite V (Fig. 1G, J), sclerites fused, anterior part with 10-11 setae, lateral part with 5-6 setae, posterior part with 12 setae; three pairs of hooks present, out hooks thorn-like bare and slightly curved inward; median hooks (Fig. 1H) thorn-like, apex pointed outward with 2 short stout setae on middle part; inner hooks (Fig. 1I) conical with 2 short setae; posterior margin of tergite IX (Fig. 1K) with 2 pairs of setae; pygopod (Fig. 1L) with 4 pairs of setae arrayed in a curve on caudal margin.

Instar II (n = 1)
Collecting locality:
MIAOLI County: Nanzhuang Township, Jiali Mt., 11 X 2009.

Coloration: Head yellowish brown, around stemmata I and II black; mandible yellowish brown at base, external margin and apical half dark brown; antennae pale yellowish brown; pronotum yellow brown, caudal margin yellow; abdomen creamy white; setae of body light brown.

Head (Fig. 2A): U-shaped ridge on frons with 3 setae; antennae (Fig. 2C), antennomere I with 4 setae, antennomere II with 5 setae, length ratio of antennal segments = 1.00 : 0.85 : 0.73 : 0.46; maxillae (Fig. 2E), length ratio of maxillary palpomeres = 1.00 : 1.50 : 2.00, galeomere I with 2 apical setae on inner margin, length ratio of galeae = 1.00 : 0.73; labium (Fig. 2D), basal segment of labial palpi with 5 setae at apex, central 3 setae short.

Pronotum (Fig. 2B): Anterolateral angles rounded; surface intermixed with

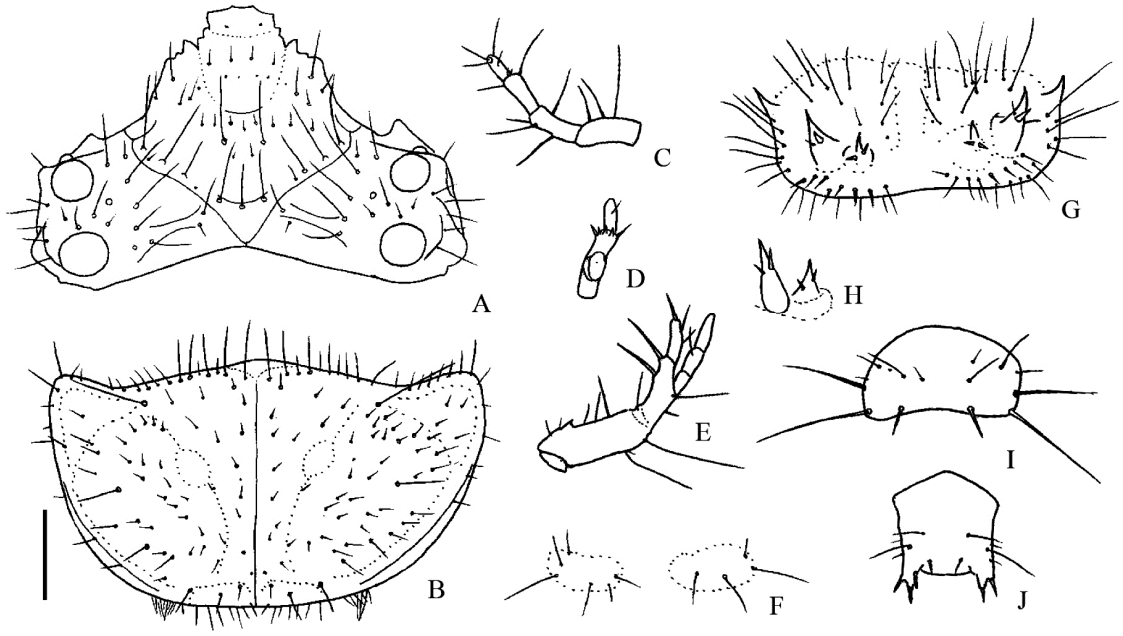

Fig. 2. *Therates alboobliquatus alboobliquatus*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (right, ventral view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G tergite V (dorsal view); H) median and inner hook (left, caudal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.4 mm].

6-7 long and more than 35 short setae on each half, setae on lateral margins sparse, caudolateral angles with a cluster of setae.

Abdomen: Tergite III (Fig. 2F) with 4-5 setae; tergite V (Fig. 2G), sclerites fused, anterior part with 9-10 setae, lateral part with 6-8 setae, posterior part with 14-15 setae; three pairs of hooks present, out hooks thorn-like, bare and slightly curved inward; median hooks (Fig. 2H) thorn-like, apex pointed inward with 2 short setae; inner hooks (Fig. 2H) conical with 2 short setae; posterior margin of tergite IX (Fig. 2I) with 2 pairs of setae; pygopod (Fig. 2J) with 7 setae on caudal margin.

Instar I (n = 1)
Collecting locality:
MIAOLI County: Nanzhuang Township, Jiali Mt., 2009.

Coloration: Head creamy yellow, around stemmata I and II pale brown; antennae creamy yellow; mandible creamy yellow at base, margin and apical half reddish brown; pronotum and abdomen semi-transparent; setae of body transparent white.

Head (Fig. 3A): Antennae (Fig. 3C), antennomere II with 2 setae, length ratio of antennal segments = 1.00 : 0.75 : 0.88 : 1.00; maxillae (Fig. 3E) length ratio of maxillary palpomeres = 1.00 : 1.33 : 2.67, length ratio of galeae = 1.00 : 0.64.

Pronotum (Fig. 3B): Anterolateral angles rounded; Surface with 6 setae on each half, lateral margins nearly bare, caudolateral angles with a cluster of setae.

Abdomen: Tergite III with 3 setae; tergite V (Fig. 3F, G), sclerites fused, anterior part with 4 setae, lateral part with 1 seta; three pairs of hooks present, out hooks thorn-like bare; median hooks thorn-like, slightly curved with 1 seta;

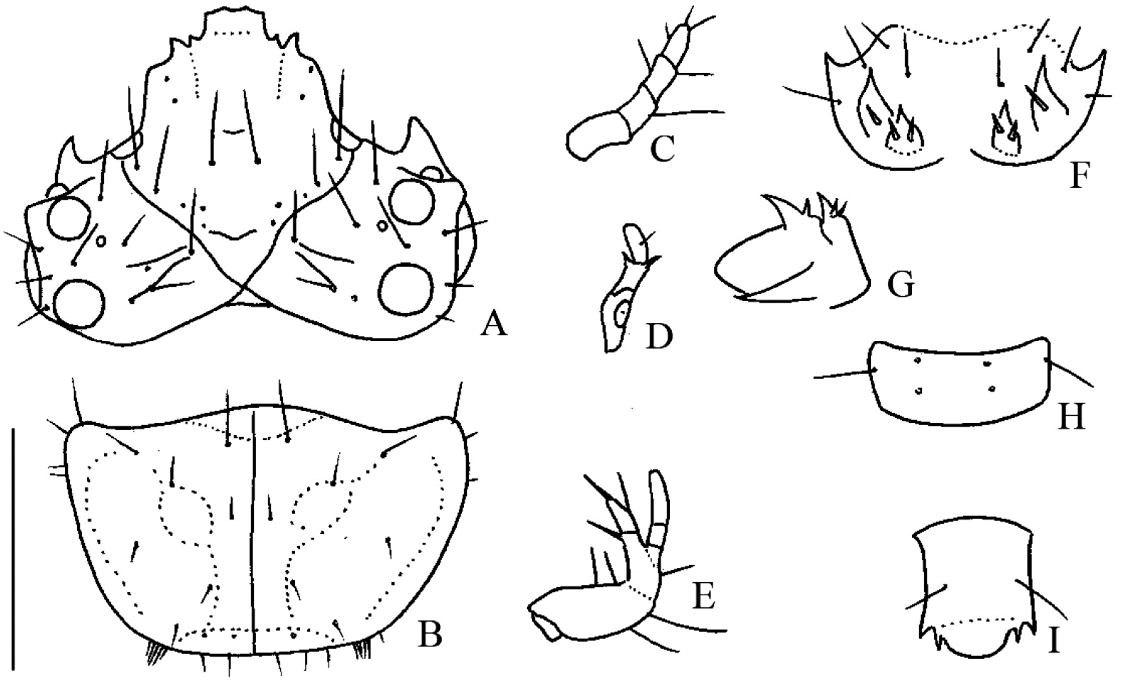

Fig. 3. *Therates alboobliquatus alboobliquatus*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D)labium (left, ventral view); E) maxilla (left, ventral view); F) tergite V (dorsal view); G) tergite V (left, lateral view); H) tergite IX (dorsal view); I) pygopod (dorsal view). [scale bar = 0.4mm].

inner hooks conical with 2 short setae; posterior margin of tergite IX (Fig. 3H) glabrous; pygopod (Fig. 3I) with 2 projections on caudal angles.

Egg (n = 1) (Fig. 4)
Collecting locality:
MIAOLI County: Nanzhuang Township, Jiali Mt., 5 VII 2009.

Figure: Length = 1.30 mm, width = 0.66 mm; chorion with luster.

Note: Adults were observed mainly on the shrubs and on the ground along a wooded path. The described second-instar larva was collected in soft, corky and rotten wood in the field, while the first- and third-instar larvae were ex ovum from field-collected adults.

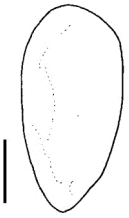

Fig. 4. *Therates alboobliquatus alboobliquatus*: embryos: ventral view. [scale bar = 0.4 mm].

***Lophyra cancellata subtilesculpta* (Horn, 1912) 多斑虎甲蟲**
Instar III (n = 4)
Collecting locality:
CHIAYI County: Yizhu Township, Guoluzi, 2010 (3 ex ovum), 10 X 2011 (1 field collection).

Coloration: Head dark brown with green luster; mandible reddish brown,

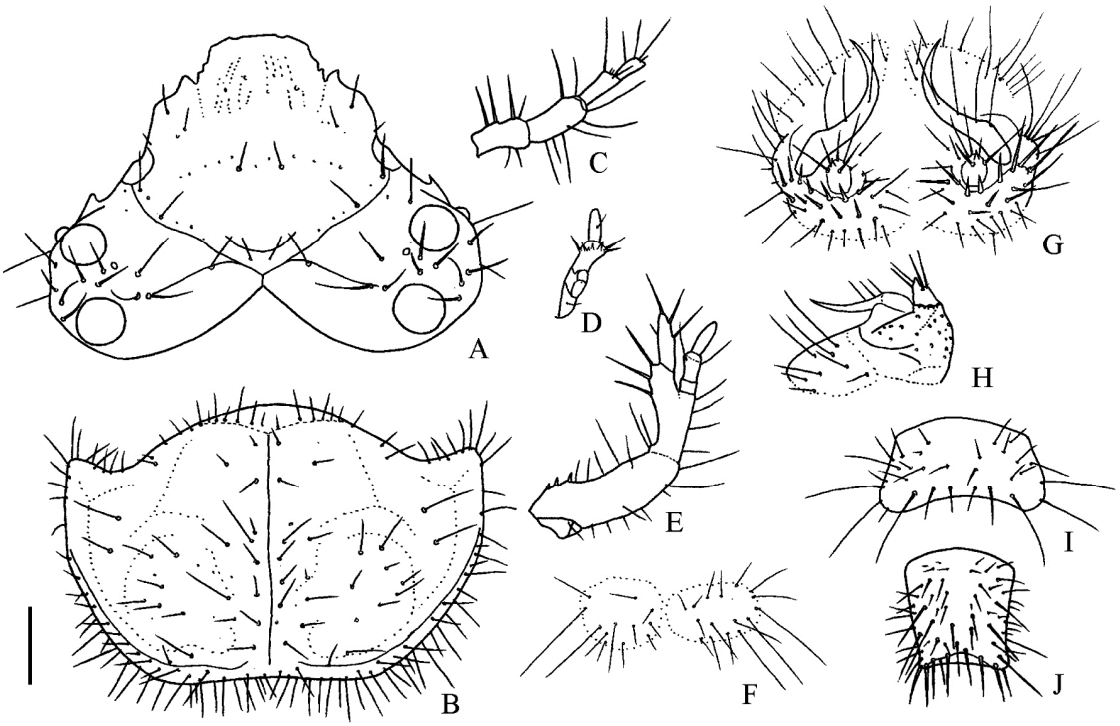

Fig. 5. *Lophyra cancellata subtilesculpta*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.5 mm].

blackish distally; antennae brown; pronotum brown, anterolateral angles and lateral margins yellowish brown; abdomen yellowish brown; setae on head and pronotum transparent white, setae on abdomen light brown.

Head (Fig. 5A): U-shaped ridge on frons with 2 setae; antennae (Fig. 5C), antennomere I with 5-7 setae, antennomere II with 9-10 setae, length ratio of antennal segments = 1.00 : 1.20 : 0.70 : 0.57; maxillae (Fig. 5E), inner margin of stipes with a row of setae and 3 spine-like protuberances on base, length ratio of maxillary palpomeres = 1.00 : 2.22 : 3.16, galeomere I with 3 apical setae on inner margin, length ratio of galeae = 1.00 : 0.61; labium (Fig. 5D), basal segment of labial palpi with 6-7 setae at apex.

Pronotum (Fig. 5B): Anterolateral angles triangular, posterior margin of pronotum straight; surface intermixed with 7 long and 13-15 short setae on each half, depressions and keels distinct; setae around lateral margins and posterior margin dense.

Abdomen: Tergite III (Fig. 5F) with 15-20 setae; tergite V (Fig. 5G, H), anterior sclerites with 14-16 setae, lateral sclerites with 5-7 setae, posterior sclerites with 35-42 setae, of which 16-20 spine-like; two pairs of hooks present, median hooks arched with 3-4 long setae, usually not equal on each side (but, one specimen with 4 setae on both sides); inner hooks conical with 4-5 setae on shoulder and a small central spine; posterior margin of tergite IX (Fig. 5I) with 4 pairs of setae; pygopod (Fig. 5J) with 10-11 setae on caudal

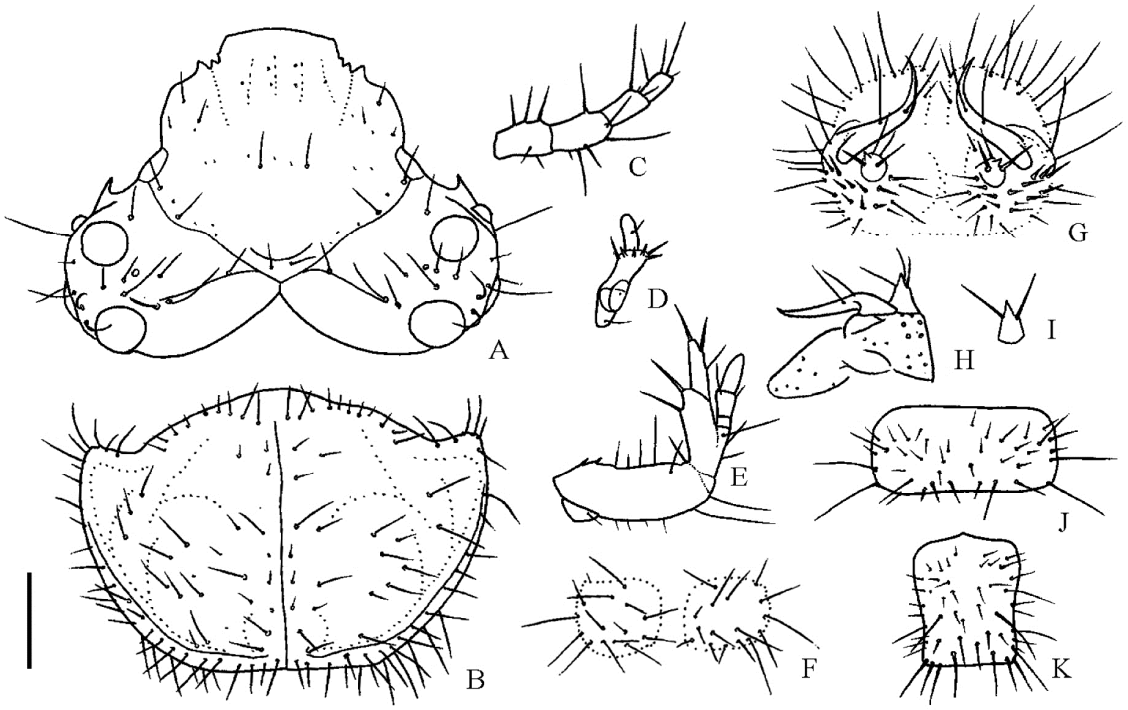

Fig. 6. *Lophyra cancellata subtilesculpta*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) inner hook (right, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.4 mm].

margin.

Instar II (n = 2)
Collecting locality:
CHIAYI County: Yizhu Township, Guoluzi, 2011.

Coloration: Head brown with green reflection; mandible pale yellowish brown at base, apical half reddish brown; antennae light brown; pronotum light brown with luster; setae on head and pronotum transparent white, setae on abdomen semi-transparent.

Head (Fig. 6A): Antennae (Fig. 6C), antennomere I with 5 setae, antennomere II with 7 setae, length ratio of antennal segments = 1.00 : 0.95 : 0.86 : 0.70; maxillae (Fig. 6E), length ratio of maxillary palpomeres = 1.00 : 1.83 : 3.10, galeomere I with 2 apical setae on inner margin, length ratio of galeae = 1.00 : 0.62.

Pronotum (Fig. 6B): Surface intermixed with 7 long and 9-12 short setae on each half, setae on lateral and caudal margins dense.

Abdomen: Tergite III (Fig. 6F) with 13-18 setae; tergite V (Fig. 6G, H), anterior sclerites with 13-14 setae, lateral sclerites with 3 long setae and 1 short seta, posterior sclerites with 21-25 setae, of which 13-15 spine-like; two pairs of hooks present, median hooks arched with 2 setae on middle part; inner hooks (Figs. 6I) conical with 3-4 setae, three on shoulder, with another fine basal seta on front, a central spine present; posterior margin of tergite IX (Fig. 6J) with 9-10 setae; pygopod (Fig. 6K) with 7-8 setae on caudal margin.

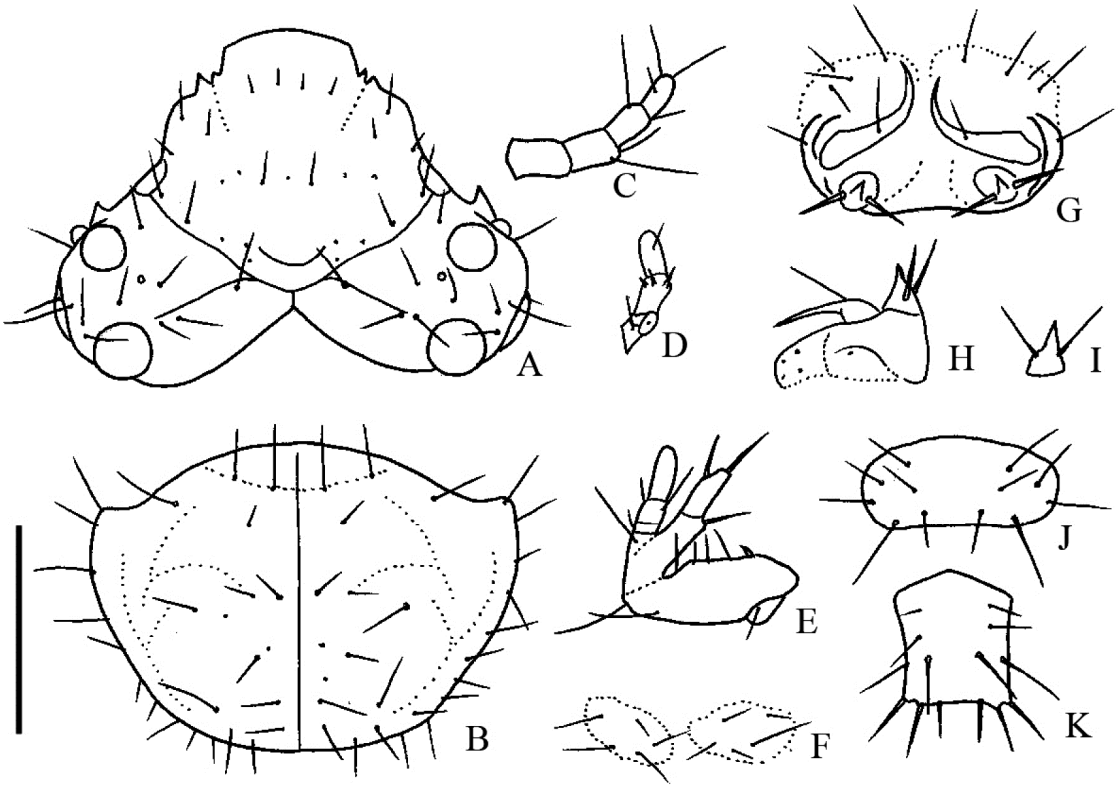

Fig. 7. *Lophyra cancellata subtilesculpta*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D)labium (left, ventral view); E) maxilla (right, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) inner hook (right, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

Instar I (n = 4)
Collecting locality:
CHIAYI County: Yizhu Township, Guoluzi, 2012.

Coloration: Head and pronotum brown with luster; mandible pale yellowish brown, apical half reddish brown; antennae pale brown; abdomen pale yellowish brown; setae on head, pronotum and abdomen light brown.

Head (Fig. 7A): Antennae (Fig. 7C), antennomere II with 2 setae, length ratio of antennal segments = 1.00 : 0.93 : 0.78 : 0.82; maxillae (Fig. 7E), length ratio of maxillary palpomeres = 1.00 : 2.25 : 5.00, length ratio of galeae = 1.00 : 0.66.

Pronotum (Fig. 7B): Surface with 7 setae on each half.

Abdomen: Tergite III (Fig. 7F) with 5 setae; tergite V (Fig. 7G, H), anterior sclerites with 5-7 setae, lateral sclerites with 1 seta; two pairs of hooks present, median hooks arched with 1 seta on middle part; inner hooks (Fig. 7I) with 2 lateral setae and a distinct central spine; posterior margin of tergite IX (Fig. 7J) with 2 pairs of setae; pygopod (Fig. 7K) with 3 pairs of setae on caudal margin.

Egg (n = 1) (Fig. 8)
Collecting locality:
CHIAYI County: Yizhu Township, Guoluzi, 2010.

Figure: Length = 1.75 mm, width = 1.05 mm; chorion with luster, interior tissues creamy white, stemmata and

mandible pre-formed.

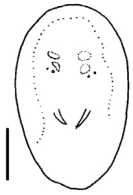

Fig. 8. *Lophyra cancellata subtilesculpta*: embryos: ventral view. [scale bar = 0.5 mm].

Pupa (n = 2) (Fig. 9A, B)
Collecting locality:
CHIAYI County: Yizhu Township, Guoluzi, 2011, 2013.

Figure: Length = 9.1-10.6 mm; compound eyes grayish brown; body creamy yellow, setae of spurs pale brown; tergites I-V with paired dorsal spurs; length of spurs IV = 0.65-0.85 mm, apex of spurs I-IV with 4 setae; length of spurs V = 0.90-1.10mm, apex of spurs V each with 7-9 setae arrayed in a circle.

Habitat: Adults were found on bare ground of fairly dry and high-level sandy flats close to cultivated land along a river. The larvae shared their habitat with adults, and the larval burrows were dispersed over the area.

***Lophyra striolata dorsolineolata* (Chevrolat, 1845) 縱紋虎甲蟲**
Instar III (n = 3)
Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 14 IX 2003 (2 field collections), 2010 (1 ex ovum).

Coloration: Head dark brown to black; pronotum dark brown, anterolateral angles and apical half of lateral margins pale brown; mandible dark reddish brown basally, otherwise black; antennae brown; abdomen yellowish; setae on head and pronotum transparent white, setae on abdomen light brown.

Head (Fig. 10A): Setae around stemmata I bifurcate; U-shaped ridge on frons with 2 setae; antennae (Fig. 10C, D), antennomere I with 5 setae, antennomere II with 6 setae, length ratio of antennal segments = 1.00 : 1.03 : 0.77 : 0.74; maxillae (Fig. 10F), inner margin of stipes with one row of setae and 2 spine-like protuberances on base, length ratio of maxillary palpomeres = 1.00 : 1.70 : 2.32, galeomere I with 3 setae on inner margin apical, length ratio of galeae = 1.00 : 0.43; labium (Fig. 10E), basal segment of labial palpi with 6-7 setae at apex.

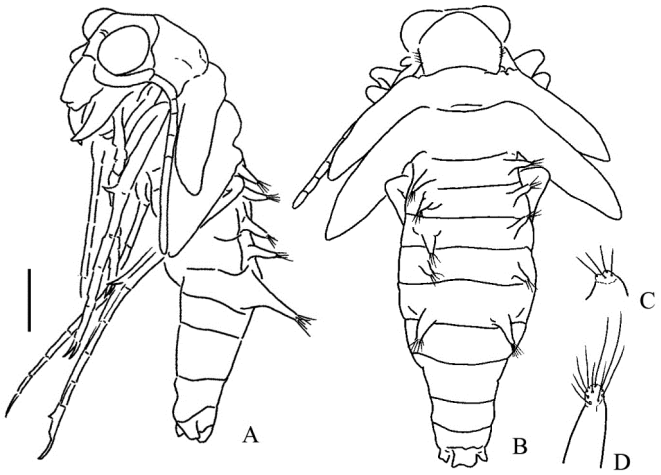

Fig. 9. *Lophyra cancellata subtilesculpta*: pupa: A) lateral view; B) dorsal view; C) apex of spur IV; D) apex of spur V. [scale bar A & B = 1 mm, C & D = 0.4 mm].

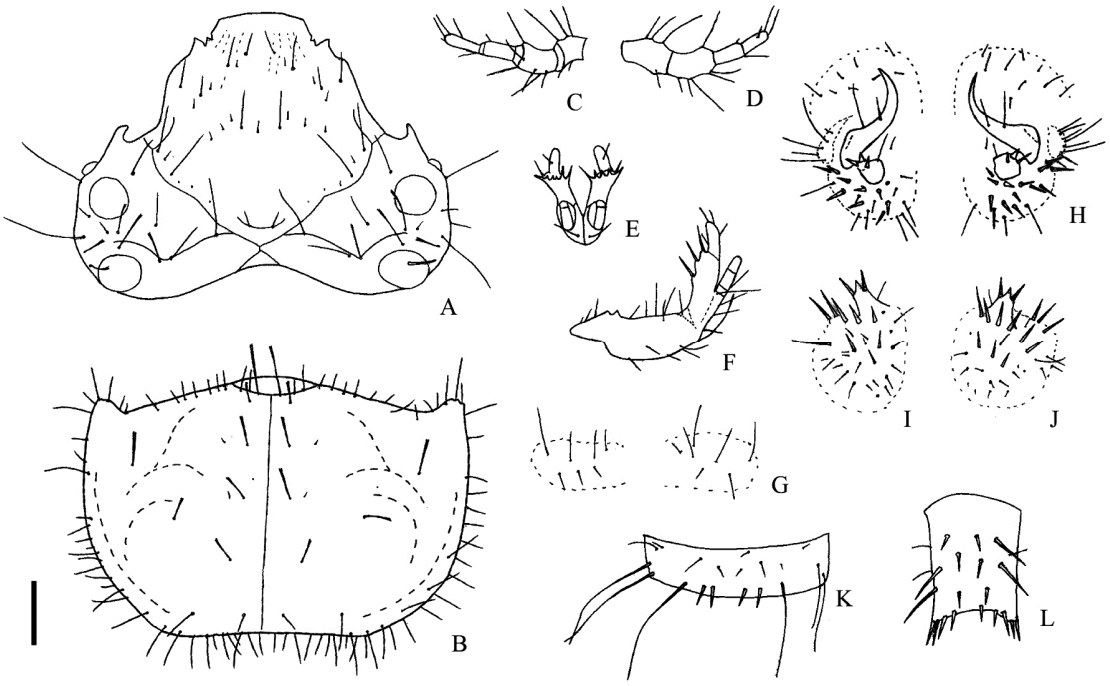

Fig. 10. *Lophyra striolata dorsolineolata*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) antenna (left, ventral view); E) labium (ventral view); F) maxilla (left, ventral view); G) tergite III (dorsal view); H) tergite V (dorsal view); I+J) inner hooks and posterior sclerites (caudal view) ; K) tergite IX (dorsal view); L) pygopod (dorsal view). [scale bar = 0.5 mm].

Pronotum (Fig. 10B): Anterolateral angles acute, posterior margin slightly concave; surface intermixed with 7 long bifurcate setae and 2 short setae on each half; depressions distinct.

Abdomen: Tergite III (Fig. 10G) with 7-9 setae; tergite V (Fig. 10H) anterior sclerites with 10 setae, lateral sclerites with 8-11 setae, posterior sclerites (Fig. 10I, J) with 30 setae, of which 14-15 thorn-like setae; two pairs of hooks present; median hooks stout and arched with 2 setae on middle part, inner hooks (Fig. 10I, J) conical with 2 setae laterally and 1 fine seta on front basally, central spine short; posterior margin of tergite IX (Fig. 10K) with 4 pairs of setae, central 2 pairs thorn-like; pygopod (Fig. 10L) with 9-10 thorn-like setae on caudal margin.

Instar II (n = 1)

Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 2010.

Coloration: Head dark brown; mandible brown basally, the rest dark brown; antennae brown; pronotum dark brown, anterolateral angles brown; abdomen pale yellow; setae on head and pronotum transparent white, setae on abdomen light brown.

Head (Fig. 11A): Setae around stemmata I bifurcate; antennae (Fig. 11C), antennomere I with 4 setae, antennomere II with 6 setae, length ratio of antennal segments = 1.00 : 1.40 : 1.20 : 1.07; maxillae (Fig. 11E), length ratio of maxillary palpomeres = 1.00 : 2.50 : 3.75, galeomere I with 2 setae on inner margin apical, length ratio of galeae = 1.00 : 0.64

Pronotum (Fig. 11B): Surface with 7 long setae (of which 4 bifurcate) and 2

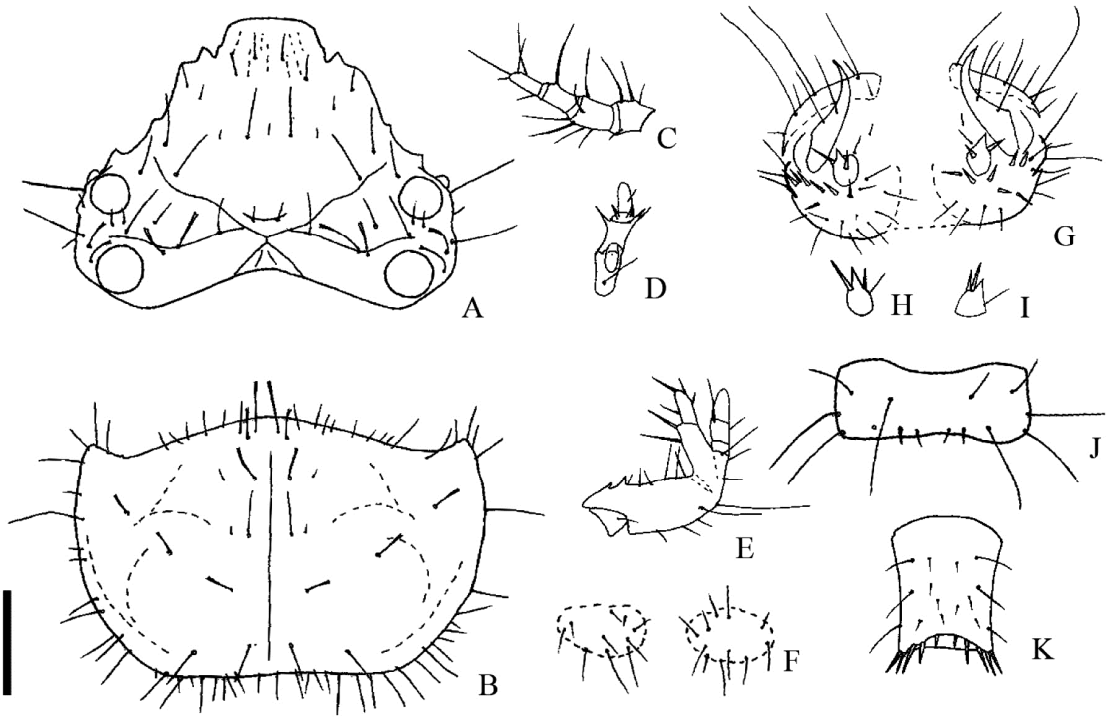

Fig. 11. *Lophyra striolata dorsolineolata*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, dorsal view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (left, caudal view) ; I) inner hook (right, lateral view) ; J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

short setae on each half.

Abdomen: Tergite III (Fig. 11F) with 11 setae; tergite V (Fig. 11G) anterior sclerites with 8 setae, lateral sclerites with 3 setae, posterior sclerites with 20 setae, of which 11 thorn-like; two pairs of hooks present, median hooks stout, arched with 2 setae on middle part; inner hooks (Fig. 11H, I) conical with 2 setae laterally and 1 fine seta on the front basally, central spine distinct; posterior margin of tergite IX (Fig. 11J) with 4 pairs of setae, middle 2 pairs thorn-like; pygopod (Fig. 11K) with 5 pairs of setae on caudal margin.

Instar I (n = 3)
Collecting locality:
TAICHUNG City: Taichung Metropolitan Park, 2010.

Coloration: Head, mandible, antennae and pronotum brown; abdomen pale yellow; setae of head and pronotum light brown to transparent white, setae on abdomen light brown.

Head (Fig. 12A): Setae around stemmata I bifurcate; antennae (Fig. 12C), antennomere II with 2 setae, length ratio of antennal segments = 1.00 : 1.00 : 1.00 : 1.53; maxillae (Fig. 12E), length ratio of maxillary palpomeres = 1.00 : 2.00 : 5.40, length ratio of galeae = 1.00 : 0.63.

Pronotum (Fig. 12B): Surface intermixed with 6 long and 1 short seta on each half.

Abdomen: Tergite III (Fig. 12F) with 3 setae; tergite V (Fig. 12G, I) anterior sclerites with 3-4 setae, lateral sclerites with 1 seta; two pairs of hooks present, median hooks arched with 1 seta; inner hooks (Fig. 12H) conical with 2 setae

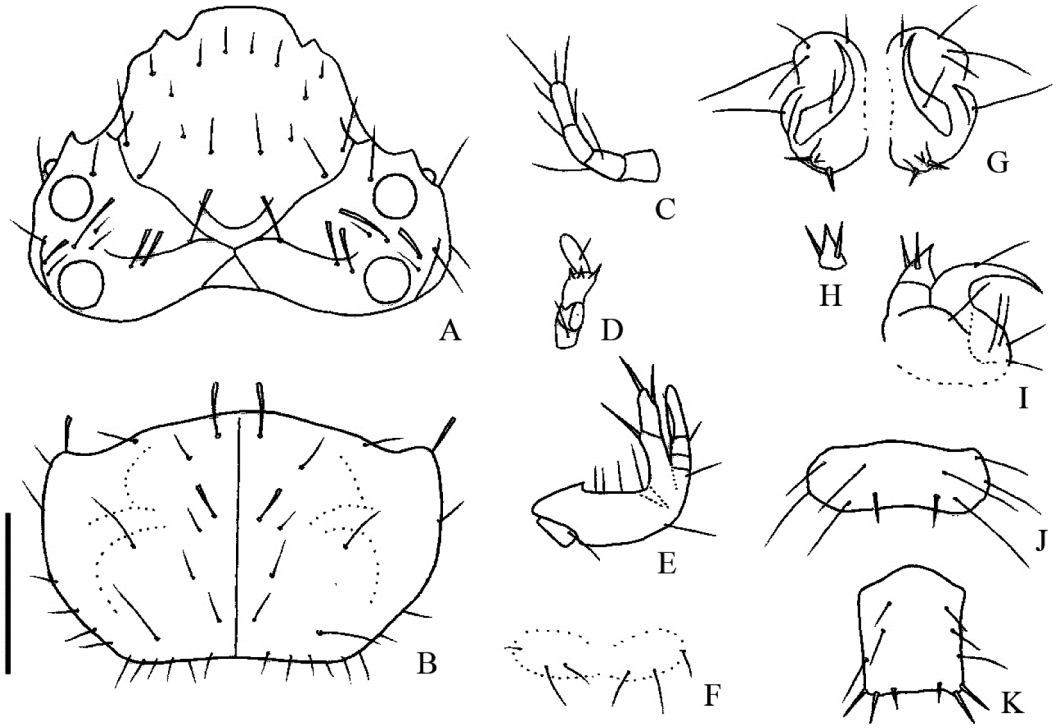

Fig. 12. *Lophyra striolata dorsolineolata*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna(left, dorsal view); D) labium (left part, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (left, caudal view) ; I) tergite V (right, lateral view) ; J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

laterally, central spine stout; posterior margin of tergite IX (Fig. 12J) with 3 pairs of setae, the central pair short; pygopod (Fig. 12K) with 3 pairs of setae on caudal margin, the central pair short.

Egg (n = 2) (Fig. 13A, B)
Locality: TAICHUNG City: Taichung Metropolitan Park, 5 VII 2010.

Figure. Length = 1.70-1.95 mm, width = 0.95-1.18 mm; developing egg, larval body segments shaped.

Habitat: Adults were observed on open paths and trails. Larvae were observed in the same habitat and in dried-up depressions on a red-clay hill.

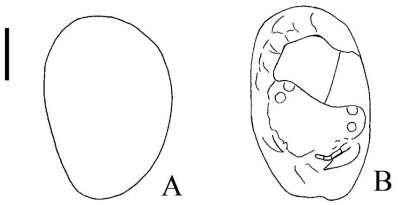

Fig. 13. *Lophyra striolata dorsolineolata*: embryos: A) undeveloped; B) developing (front view). [scale bar = 0.5 mm].

***Cylindera psilica* (Bates, 1866)** 小八星虎甲蟲
Instar III (n = 4)
Collecting locality:
NANTOU County: Lugu Township, Waicheng, 2009 (2 ex ovum), 2010 (2 ex ovum)

Coloration: Head yellowish brown;

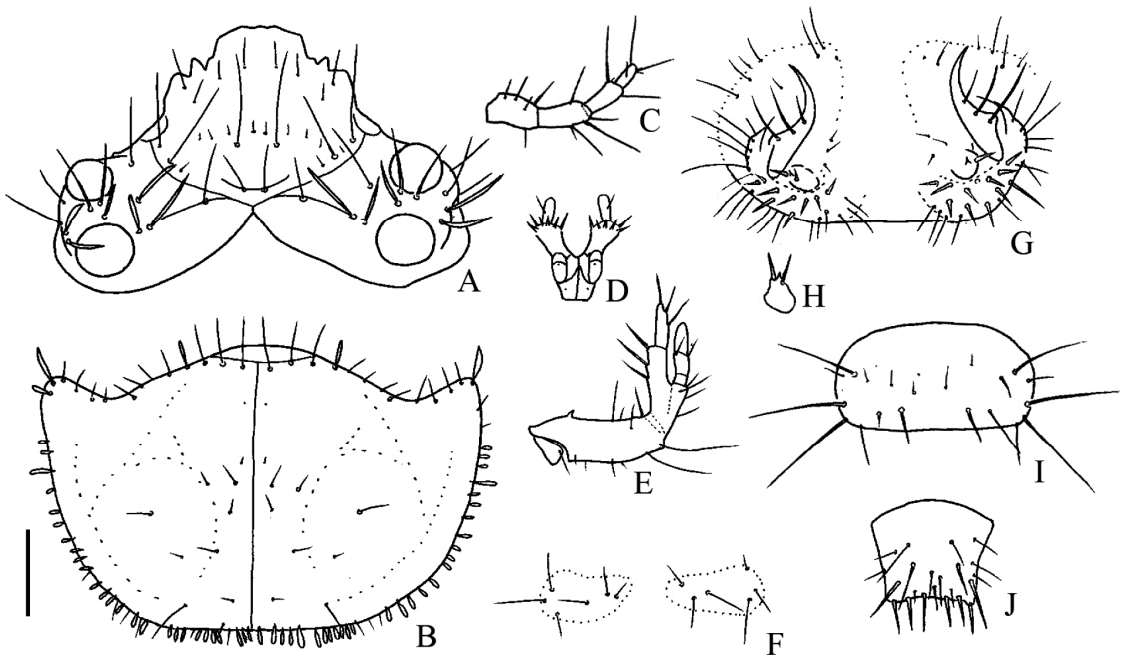

Fig. 14. *Cylindera psilica*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G tergite V (dorsal view); H) inner hook (left, caudal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.4 mm].

mandible reddish brown, black distally; antennae pale brown; pronotum light yellowish brown, anterolateral angles and narrow lateral margins pale yellow; abdomen creamy yellow; setae on body light brown.

Head (Fig. 14A): Setae around stemmata I and II flattened; U-shaped ridge on frons with 2 setae; antennae (Fig. 14C), antennomere I with 5 setae, antennomere II with 7 setae, length ratio of antennal segments = 1.00 : 0.93: 0.62 : 0.47; maxillae (Fig. 14E), inner margin of stipes with several setae and a spine-like protuberance on base, length ratio of maxillary palpomeres = 1.00 : 2.19 : 3.56; galeomere I with 3 apical setae on inner margin, length ratio of galeae = 1.00 : 0.47; labium (Fig. 14D), basal segment of labial palpi with 6-7 setae at apex.

Pronotum (Fig. 14B): Anterolateral angles produced, extending as far cephalad as the mesal portion, posterior margin of pronotum straight; surface intermixed with 6 long and 6 short setae on each half, depressions and keels distinct; slice-like setae around lateral margins and posterior margin dense.

Abdomen: Tergite III (Fig. 14F) with 7-8 setae; tergite V (Fig. 14G), anterior sclerites with 10-12 setae, lateral sclerites with 4 setae, posterior sclerites with 20-22 setae, of which 11-14 spine-like; two pairs of hooks present, median hooks arched with 3 setae on basal half, upper ones shorter than the others; inner hooks (Fig. 14H) conical with 2 setae laterally and a small central spine; posterior margin of tergite IX (Fig. 14I) with 8 setae; pygopod (Fig. 14J) with 8-9 setae on caudal margin.

Instar II (n = 3)
Collecting locality:
NANTOU County: Lugu Township, Waicheng,

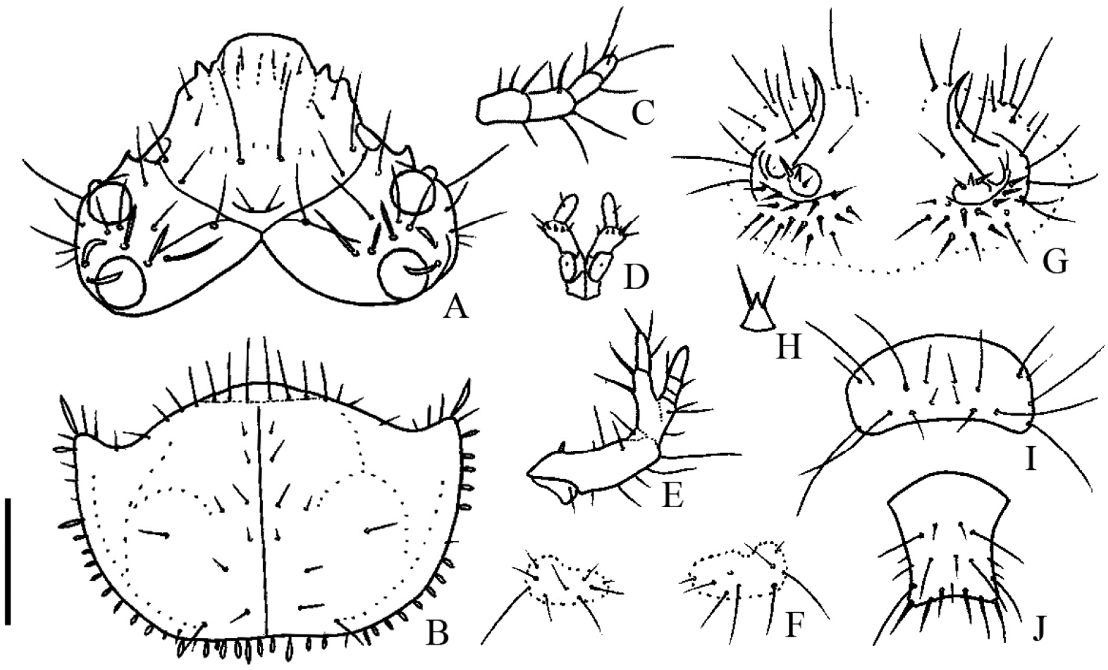

Fig. 15. *Cylindera psilica*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (left, caudal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.4 mm].

2009.

Coloration: Head yellowish brown with reflection, around stemmata I and II blackish brown; mandible reddish brown, external margin and apex blackish brown; antennomere I and II light yellowish brown, antennomere III and IV light brown; pronotum light brown, anterolateral angles creamy white; setae on head and pronotum slightly transparent white, setae on abdomen light brown.

Head (Fig. 15A): Setae around stemmata I flattened; antennae (Fig. 15C), antennomere I with 4 setae, antennomere II with 6 setae, length ratio of antennal segments = 1.00 : 1.00 : 0.76 : 0.64; maxillae (Fig. 15E), length ratio of maxillary palpomeres = 1.00 : 2.00 : 3.78, galeomere I with 2 setae on inner margin apically, length ratio of galeae = 1.00 : 0.69.

Pronotum (Fig. 15B): Surface intermixed with 5 long and 3-4 short setae on each half, setae on lateral and caudal margin slice-like.

Abdomen: Tergite III (Fig. 15F) with 6-8 setae; tergite V (Fig. 15G), anterior sclerites with 9-12 setae, lateral sclerites with 3 setae, posterior sclerites with 18 setae, of which 12-16 spine-like; two pairs of hooks present, median hooks arched with 2 setae on middle part; inner hooks (Figs. 15H) conical with 2 setae laterally and a central spine; posterior margin of tergite IX (Fig. 15I) with 3 pairs of setae; pygopod (Fig. 15J) with 7 setae on caudal margin.

Instar I (n = 7)
Collecting locality:
NANTOU County: Lugu Township, Waicheng, 2009 (ex ovum), 2010 (3 ex ovum), 2011 (3 ex ovum).

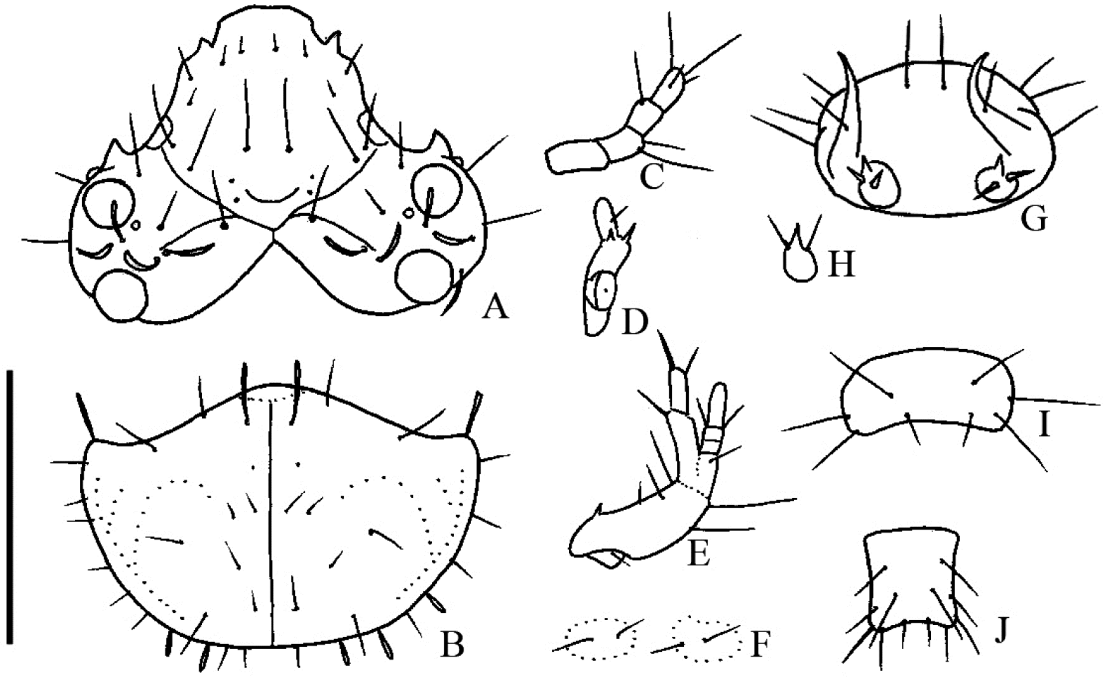

Fig. 16. *Cylindera psilica*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D)labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (left, caudal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.5 mm].

Coloration: Head yellow brown, around stemmata I and II blackish brown; mandible brown; antennae pale yellowish brown, distal segment darkened; pronotum light yellowish brown; setae on head, pronotum and abdomen light yellowish brown.

Head (Fig. 16A): Setae around stemmata I flatten; antennae (Fig. 16C), antennomere II with two setae, length ratio of antennal segments = 1.00 : 0.87 : 0.72 : 0.76; maxillae (Fig. 16E), length ratio of maxillary palpomeres = 1.00 : 1.00 : 2.95, length ratio of galeae = 1.00 : 0.66.

Pronotum (Fig. 16B): Surface with 5 long setae on each half, some setae on caudal angles slice-like.

Abdomen: Tergite III (Fig. 16F) with 2-3 setae; tergite V (Fig. 16G), anterior sclerites with 3 setae, lateral sclerites with 1 seta, two pairs of hooks present, median hooks arched with 1 seta (except one specimen with 2 setae) on middle part; inner hooks (Fig. 16H) with 2 setae laterally and a distinct central spine; posterior margin of tergite IX (Fig. 16I) with 2 pairs of setae; pygopod (Fig. 16J) with 3 pairs of setae on caudal margin.

Fig. 17. *Cylindera psilica*: embryos: A) ventral view; B) lateral view; C) dorsal view [scale bar = 0.4 mm].

Egg (n = 3) (Fig. 17)
Collecting locality:

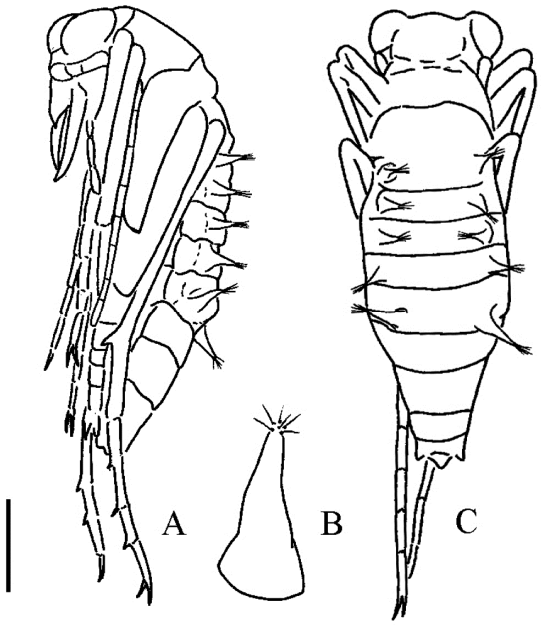

Fig. 18. *C ylindera psilica*: pupa: A) lateral view; B) spur V; C) dorsal view. [scale bar A & C = 2 mm, B =0.4 mm].

NANTOU County: Lugu Township, Waicheng, 2012.

Figure: Length = 1.00-1.16 mm, width = 0.66-0.72 mm; larval body segments shaped.

Pupa (n = 1) (Fig. 18A, C)
Collecting locality:
NANTOU County: Lugu Township, Waicheng, 2010.

Figure: Length = 7.7 mm; body creamy yellow; tergites I-V with paired dorsal spurs; length of spurs IV = 0.50 mm, apex of spurs I-IV with 2-3 setae; length of spurs V = 0.76 mm, apex of spurs V (Fig. 18B) each with a ring made-up by 5-6 setae.

Habitat: The adults were observed in diverse habitats including open or shady paths and on the edge of wooded areas.

Note: Larval burrows are seldom found in the field. The third instar larvae of *C. psilica* are easily distinguished from those of other species by their slice-like setae around the lateral and posterior margin of the pronotum. They are however very similar to the co-generic larvae of *C. kaleea* in most of their characteristics and measurements, and can only be separated by their shoulder setae position and the length of central spine on the inner hooks.

***Cylindera elisae reductelineata* (Horn, 1912) 暗紋虎甲蟲**
Instar III (n = 12)
Collecting locality:
YILAN County: Nanao Township, Hanben, Heping river estuary, 19 III 2003 (1 field collection).
HUALIEN County: Fongbin Township, Dagangkou, 19 II 2003. Xioulin Township, Heping river estuary, 18 III 2003. Heping river alt.140m, 18 III 2003 (1 field collection per locality).
NANTOU County: Shueili Township, Shueili river confluence, 31 XII 2002 (4 field collections). Renai Township, Chunyang, 9 V 2004 (1 field collection).
CHIAYI County: Zhongpu Township, Haoshouzhuang, Bazhang riverside, 2012

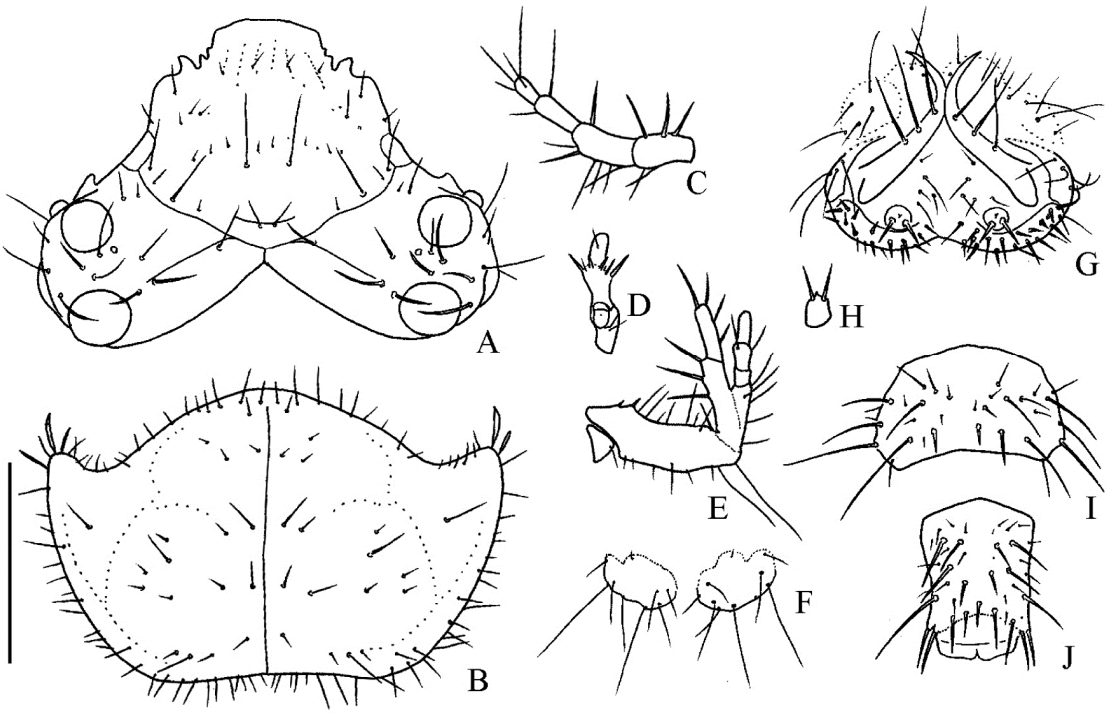

Fig. 19. *Cylindera elisae reductelineata*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (right, ventral view); D) labium (right, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (right, caudal view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 1 mm].

(3 ex ovum).

Coloration: Head and pronotum dark brown; mandible light brown, darker distally; antennae brown; setae on head and pronotum whitish or slightly transparent, setae on abdomen light brown.

Head (Fig. 19A): U-shaped ridge on frons with 2 setae; antennae (Fig. 19C), antennomere I with 6-7 setae; antennomere II with 7-8 setae, length ratio of antennal segments = 1.00 : 1.04 : 0.77 : 0.52, maxillae (Fig. 19E), inner margin and external margin of stipes each with a row of setae, two spine-like protuberances on base; length ratio of maxillary palpomeres = 1.00 : 1.99 : 2.67; galeomere I with 3 setae on inner margin apically; length ratio of galeae = 1.00 : 0.61; labium (Fig. 19D), basal labial palpomere with 7 setae at apex.

Pronotum (Fig. 19B): Anterolateral angles produced; surface intermixed with six long and 9-11 short setae on each half; depressions distinctly.

Abdomen: Tergite III (Fig. 19F) with 9-10 setae; tergite V (Fig. 19G), anterior sclerites with 7-16 setae, lateral sclerites with 4-5 setae (8 setae exceptional), posterior sclerite with 20-33 setae; two pairs of hooks present, median hooks slender and arched with 3 setae on middle part; inner hooks (Fig. 19H) with 2 setae laterally and a tiny central spine; posterior margin of tergite IX (Fig. 19I) with 8-9 setae; pygopod (Fig. 19J) with 8-9 of setae on caudal margin.

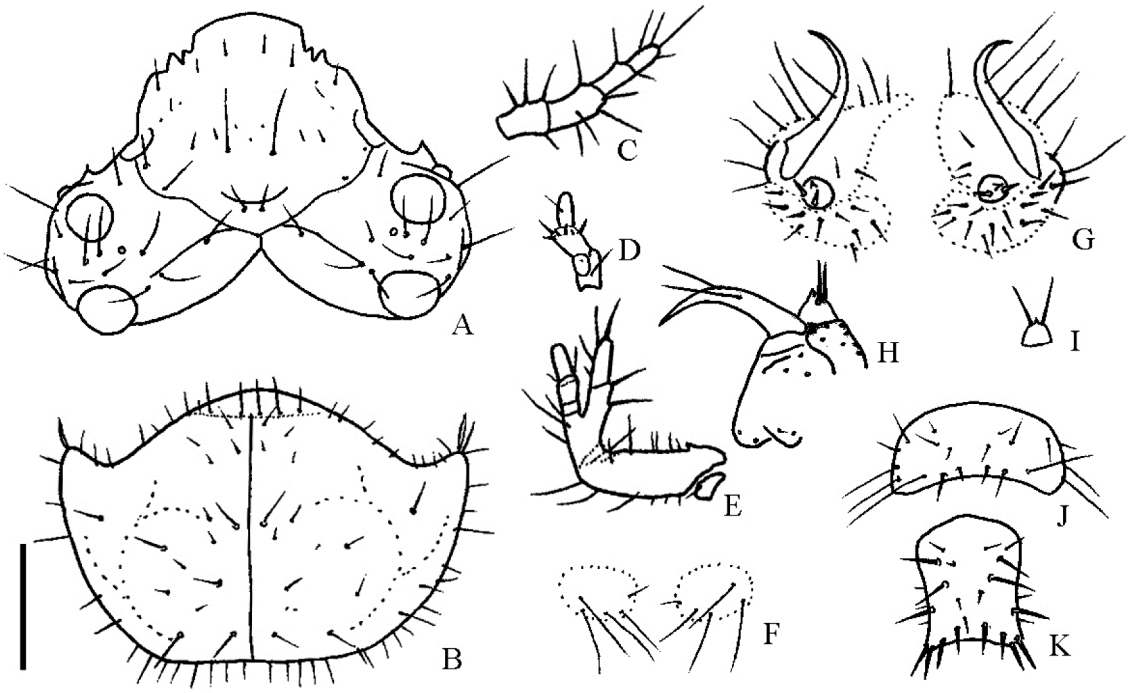

Fig. 20. *Cylindera elisae reductelineata*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (right, dorsal view); D) labium (right, ventral view); E) maxilla (right, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) inner hook (right, caudal view) J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.4 mm].

Instar II (n = 4)
Collecting locality:
CHIAYI County: Zhongpu Township, Haoshouzhuang, Bazhang riverside, 2012.

Coloration: Head blackish brown with reflection; mandible basal half yellowish brown gradually turning blackish brown to apex; antennae brown; pronotum brown with luster; setae on head and pronotum creamy white or slightly transparent; setae on abdomen light brown.

Head (Fig. 20A): Antennae (Fig. 20C), antennomere I and II with six setae respectively, length ratio of antennal segments = 1.00 : 1.02 : 0.76 : 0.68; maxillae (Fig. 20E), length ratio of maxillary palpomeres = 1.00 : 1.90 : 3.42, galeomere I with 2 setae on inner margin apically, length ratio of galeae = 1.00 : 0.69.

Pronotum (Fig. 20B): Surface intermixed with 6 long and 6-8 short setae on each half.

Abdomen: Tergite III (Fig. 20F) with 5-6 setae; tergite V (Fig. 20G, H), anterior sclerites with 10-14 setae, lateral sclerites with 2 setae, posterior sclerites with 20-22 setae; two pairs of hooks present, median hooks slender, arched with 2 long setae on middle part; inner hooks (Fig. 20I) with 2 setae laterally and a tiny central spine; posterior margin of tergite IX (Fig. 20J) with three pairs of setae; pygopod (Fig. 20K) with four pairs of setae on caudal margin.

Instar I (n = 7)
Collecting locality:
CHIAYI County: Zhongpu Township,

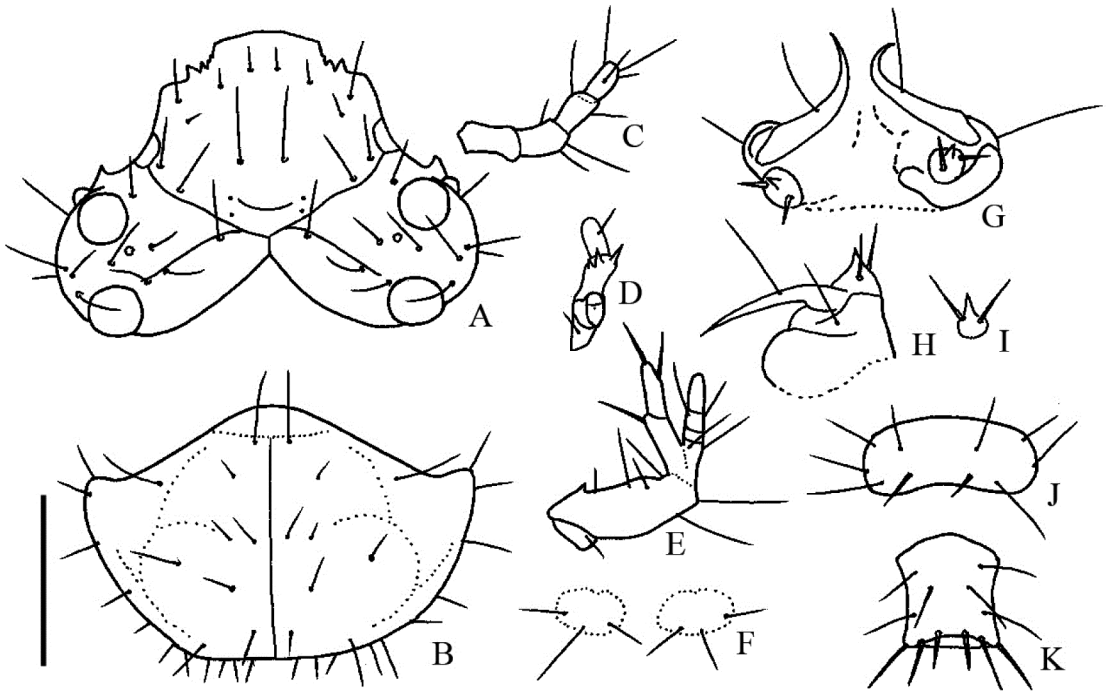

Fig. 21. *Cylindera elisae reductelineata*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (right, dorsal view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) inner hook (right, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.4 mm].

Haoshouzhuang, Bazhang riverside, 2012.

Coloration: Head and pronotum brown with luster; mandible basal half yellowish brown gradually turning blackish brown to apex; antennae reddish brown; setae on body pale yellowish brown.

Head (Fig. 21A): Antennae (Fig. 21C), antennomere II with 3 setae, length ratio of antennal segments = 1.00 : 1.04 : 0.87 : 0.84; maxillae (Fig. 21E), length ratio of maxillary palpomeres = 1.00 : 2.00 : 4.86, length ratio of galeae = 1.00 : 0.70.

Pronotum (Fig. 21B): Surface with 5 long and 2 short setae on each half.

Abdomen: Tergite III (Fig. 21F) with 3-4 setae; tergite V (Fig. 21G, H), anterior sclerites with 3-4 setae, lateral sclerites with 1 seta; two pairs of hooks present, median hooks slender, arched with 1 seta on middle part; inner hooks (Fig. 21I) with 2 setae laterally and a prominent central spine; posterior margin of tergite IX (Fig. 21J) with 2 pairs of setae; pygopod (Fig. 21K) with 3 pairs of setae on caudal margin.

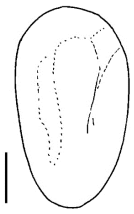

Fig. 22. *Cylindera elisae reductelineata*: embryos: lateral view. [scale bar = 0.6 mm].

Egg (n = 1) (Fig. 22)
Collecting locality:
CHIAYI County: Zhongpu Township,

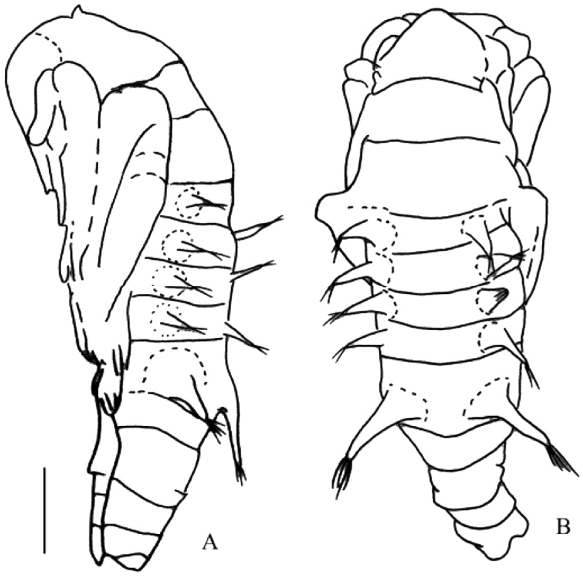

Fig. 23. *Cylindera elisae reductelineata*: pupa: A) lateral view; B) dorsal view. [scale bar = 1.25 mm].

Haoshouzhuang, Bazhang riverside, 2012.

Figure: Length = 2.33mm, width = 0.88mm; chorion slightly transparent, interior tissues creamy white.

Pupa (n = 5) (Fig. 23)
Collecting locality:
NANTOU County: Renai Township, Chunyang, 2004 (ex larva).
CHIAYI County: Zhongpu Township, Haoshouzhuang, Bazhang riverside, 2013 (4 ex ovum).

Figure: Length = 6.90-8.50 mm; compound eyes grayish brown; antennae grayish white; mandible light brown at base, distal black with purple luster; dorsal segments creamy yellow; elytra light brown; tergite spurs brown to black, setae on spur pale brown; ventral segments creamy yellow; tergites I-V with paired dorsal spurs, length of spurs IV = 0.60-0.80 mm, apex of spurs I-IV with 3-4 setae, length of spurs V = 0.90-1.10 mm, apex of spurs V each with a ring made-up by 7-8 setae.

Habitat: The larvae were found on bare, sun-exposed sandy flats, or on sparsely vegetated moist sandy locations along the river.

Note: The larvae of *C. e. reductelineata* are quite similar to those of *C. e. formosana*. Only the 3rd instar larvae can be distinguished by their shorter central spine. The habitats of these 2 subspecies were basically isolated, but the adults were observed sympatrically in some sites.

***Abroscelis anchoralis anchoralis* (Chevrolat, 1845)** 大錨紋虎甲蟲
Instar III (n = 6)
Collecting locality:
NEW TAIPEI City: Gongliao Dist, Yenliao, 20 III 2003 (1 field collection), 17-18 X 2003 (2 field collections), 19 VI 2011 (1 field collection), 12 VIII 2012 (2 field collections).

Coloration: Head brown to dark brown with green luster; mandible basal half dark yellow, apical half reddish brown; antennae pale brown; pronotum light brown to brown with luster, anterolateral angles, swellings, narrow lateral margins and posterior margin pale yellow;

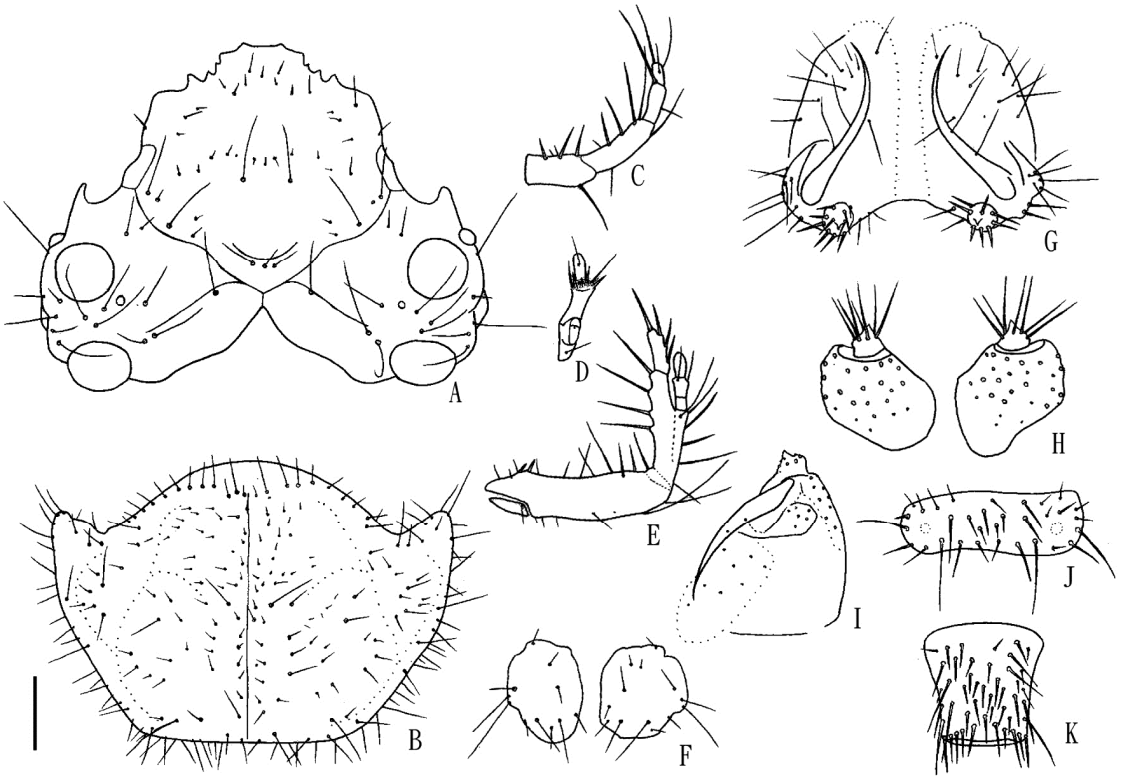

Fig. 24. *Abroscelis anchoralis anchoralis*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hooks and posterior sclerites (caudal view); I) tergite V (left, lateral view, setae removed); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

abdomen yellowish, the other sclerites light brown; setae on head and pronotum transparent white, setae on abdomen light brown.

Head (Fig. 24A): Anterior margin of nasale with two small projections; U-shaped ridge on frons with 2 or 3 setae; antennae (Fig. 24C), antennomere I with 6 setae, antennomere II with 9 setae, length ratio of antennal segments = 1.00 : 1.16 : 0.65 : 0.46; maxillae (Fig. 24E), inner margin of stipes with a row of setae and 2 spine-like protuberances on base, length ratio of maxillary palpomeres = 1.00 : 1.58 : 1.90, galeomere I with 4 setae on inner margin apically, length ratio of galeae = 1.00 : 0.49; labium (Fig. 24D), basal segment of labial palpi with 6 setae at apex.

Pronotum (Fig. 24B): Anterolateral angles acute, posterior margin straight; surface intermixed with 8 long and more than 40 short setae on each half, depressions distinct; setae around lateral margins and posterior margin dense.

Abdomen: Tergite III (Fig. 24F) with 10-12 setae; tergite V (Fig. 24G, I), anterior sclerites with 10-15 setae, lateral sclerites with 5-6 setae, posterior sclerites (Fig. 24H) with 21-22 setae; two pairs of hooks present, median hooks slender and arched with 2 long setae on middle part; inner hooks (Fig. 24H) conical with a ring made-up by 8-9 setae on shoulder, and

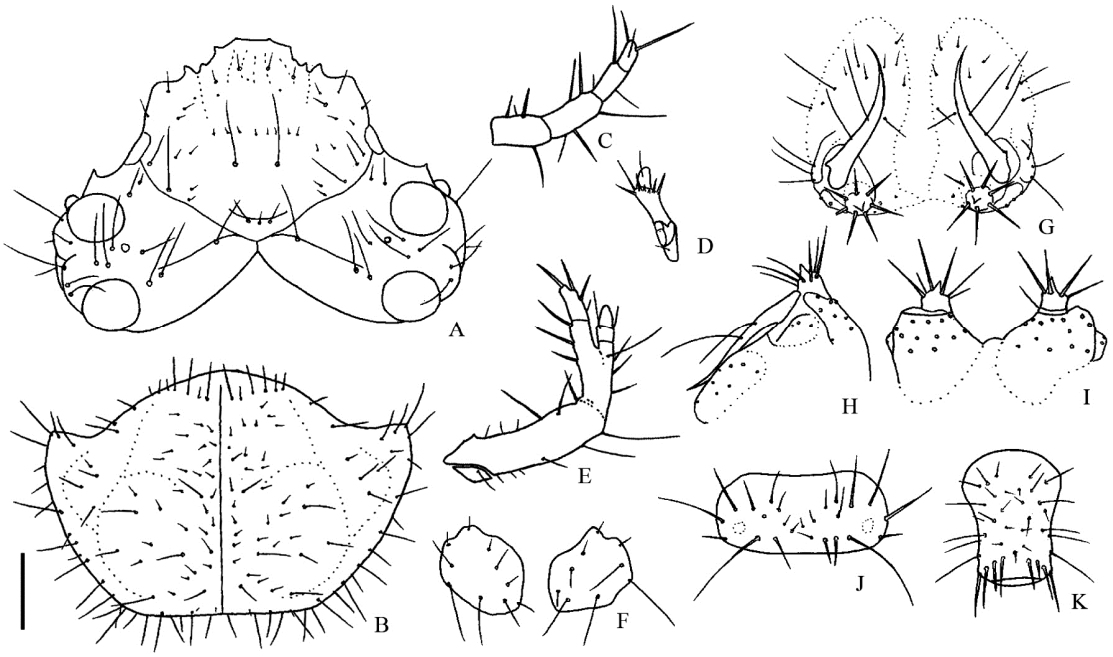

Fig. 25. *Abroscelis anchoralis anchoralis*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (right, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) inner hooks and posterior sclerites (caudal view; J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.4 mm].

with a central spine; posterior margin of tergite IX (Fig. 24J) with 8-9 setae; pygopod (Fig. 24K) with 5 pairs of setae on caudal margin.

Instar II (n = 6)
Collecting locality:
NEW TAIPEI City: Gongliao District, Yenliao, 16 X 2003 (1 field collection), 1 XI 2003 (1 field collection), 19 VI 2011 (1 field collection), 12 VIII 2012 (3 field collections).

Coloration: Head light brown with reflection; mandible brown, apical half dark brown; antennae light brown; pronotum light brown, anterolateral angles, narrow lateral margins and posterior margin creamy white; setae on head and pronotum slightly transparent white, setae on abdomen light brown.

Head (Fig. 25A): Antennae (Fig. 25C), antennomere I with 5-7 setae, antennomere II with 6-7 setae, length ratio of antennal segments = 1.00 : 1.17 : 0.72 : 0.54; maxillae (Fig. 25E), length ratio of maxillary palpomeres = 1.00 : 1.64 : 2.47, galeomere I with 3 apical setae on inner margin, length ratio of galeae = 1.00 : 0.53.

Pronotum (Fig. 25B): Surface intermixed with 7 long and 16-26 short setae on each half.

Abdomen: Tergite III (Fig. 25F) with 7-11 setae; tergite V (Fig. 25G, H), anterior sclerites with 7-9 setae, lateral sclerites with 3-4 setae, posterior sclerites with 15-18 setae; two pairs of hooks present, median hooks arched with 2 setae on middle part; inner hooks (Figs. 25I) conical with a ring made-up by 8 setae on shoulder and a central spine; posterior margin of tergite IX (Fig. 25J) with 6-8 setae; pygopod (Fig. 25K) with 4 pairs of

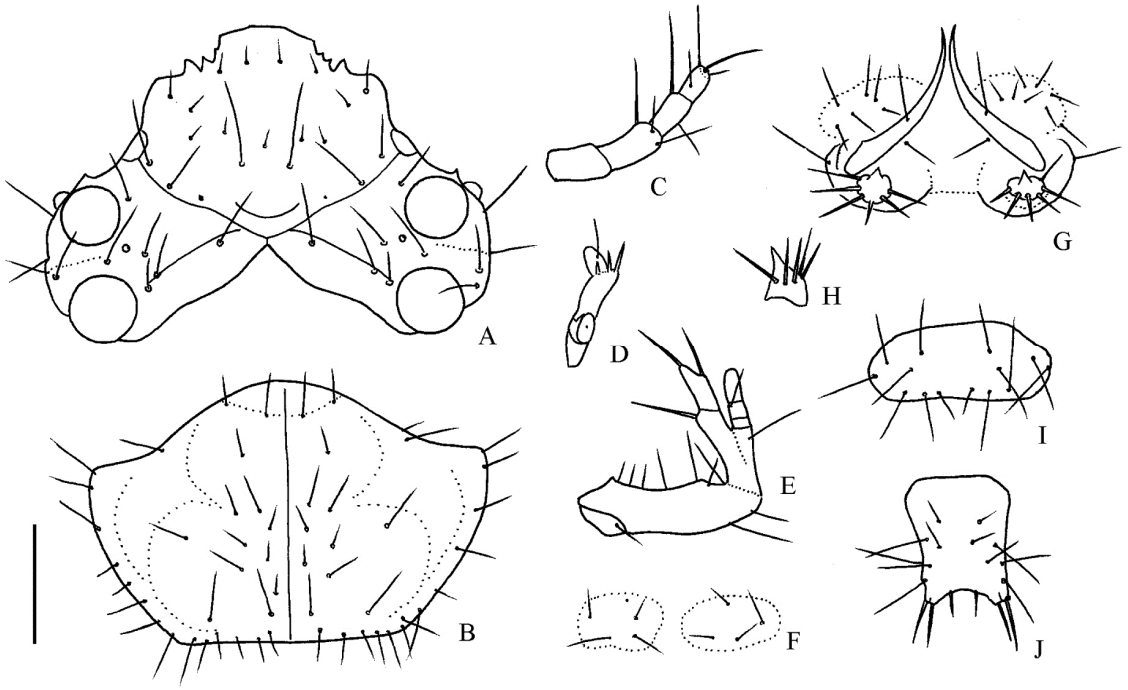

Fig. 26. *Abroscelis anchoralis anchoralis*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D)labium (left, ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook (left, lateral view); I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.4 mm].

setae on caudal margin.

Instar I (n = 3)
Collecting locality:
NEW TAIPEI City: Gongliao District, Yenliao, 19 VI 2011 (1 field collection), 12 VIII 2012 (2 field collections).

Coloration: Head brown with purple luster; mandible yellowish brown at base, apical half dark brown; antennae light brown, distal segment darkened; pronotum brown, anterolateral angles, lateral margins and posterior margin creamy white; setae on head transparent white, setae on pronotum and abdomen light brown.

Head (Fig. 26A): Antennae (Fig. 26C), antennomere II with 3 setae, length ratio of antennal segments = 1.00 : 1.33 : 0.94 : 0.73; maxillae (Fig. 26E), length ratio of maxillary palpomeres = 1.00 : 1.67 : 3.17, length ratio of galeae = 1.00 : 0.67.

Pronotum (Fig. 26B): Surface intermixed with 5 long and 5 short setae on each half.

Abdomen: Tergite III (Fig. 26F) with 4 setae; tergite V (Fig. 26G), anterior sclerites with 6-7 setae, lateral sclerites with 1 seta; two pairs of hooks present, median hooks arched with 1 seta on middle part; inner hooks (Fig. 28H) with an arc consisting of 6 setae on shoulder and a distinct central spine; posterior margin of tergite IX (Fig. 28I) with 3 pairs of setae; pygopod (Fig. 28J) with 3 pairs of setae on caudal margin.

Pupa (n = 2) (Fig. 27)
Collecting locality:
NEW TAIPEI City: Gongliao District, Yenliao, 2011, 2012.

Figure: Length = 11.9-12.5 mm; compound eyes light brown; antennae pale

brown; mandible dark yellow at base, serration blackish brown; dorsal segments dark yellow; elytra dark yellow; tergite spurs yellow; setae of spurs pale brown; ventral segments dark yellow; tergites I-V with paired dorsal spurs; length of spurs IV = 1.00 mm, apex of spurs I-IV with 4 setae; length of spurs V = 1.20 mm, apex of spurs V (Fig. 29B) each with a ring made-up by 9 setae.

Habitat: Adults and larvae were found on moist sandy beach with little wave action, but likely covered at times by high tides.

Note: The distribution of this subspecies is very restricted, mainly to some sites of the northeastern coast. The larvae of *A. a. anchoralis* are similar to *A. a. punctatissima*, and for now can only be distinguished by the width of their head. It will require further research to discuss their identities in detail.

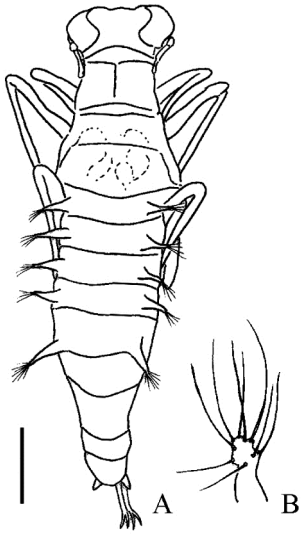

Fig. 27. *Abroscelis anchoralis anchoralis*: pupa: A) dorsal view; B) apex of spur V. [scale bar A = 2 mm, B = 0.4 mm].

***Abroscelis anchoralis punctatissima* (Schaum, 1863) 錨紋虎甲蟲**

Instar III (n = 7)

Collecting locality:

TAINAN City: Qigu Dist, Shihfen Vlg, Dingtou-e sandbank, 26 X 2003 (3 field collections).

HSINCHU City: Xiangshan Dist, Haishangu, 20 IX 2010 (1 field collection). Xiangshan Dist, Nangang Vlg, 26-27 X 2011 (3 field collections).

Coloration: Head brown with purple luster; mandible brown, apical half dark brown; antennae light yellowish brown, distal segment brown; pronotum light brown to brown with luster, anterolateral angles, narrow lateral margins and caudal margin creamy white; abdomen light brown; setae on head and pronotum transparent white, setae on abdomen light brown.

Head (Fig. 28A): Anterior margin of nasale with 2 small projections; U-shaped ridge on frons with 2 (rare 3) setae; antennae (Fig. 28C), antennomere I with 6 setae; antennomere II with 8 setae; length ratio of antennal segments = 1.00 : 1.21 : 0.65 : 0.44; maxillae (Fig. 28E), inner margin of stipes with 1 row of setae and 3 spine-like protuberances on base, length ratio of maxillary palpomeres = 1.00 : 1.35 : 1.68, galeomere I with 3-4 setae on inner margin apically, length ratio of galeae = 1.00 : 0.49; labium (Fig. 28D), basal segment of labial palpi with 7 setae at apex.

Pronotum (Fig. 28B): Anterolateral angles acute, posterior margin straight; surface intermixed with 7-9 long and more than 40 short setae on each half, depressions distinct; setae around lateral margins and posterior margin dense.

Abdomen: Tergite III (Fig. 28F) with 8-12 setae; tergite V (Fig. 28G), anterior sclerites with 9-13 setae, lateral sclerites with 4-5 setae, posterior sclerites with 21-24 setae; two pairs of hooks present, median hooks slender and arched with 2 long setae in middle part; inner hooks (Fig. 28H, I) conical with a ring arrayed by 8-10 setae on shoulder and a tiny central spine; posterior margin of tergite IX (Fig. 28J) with 6-8 of setae; pygopod (Fig. 28K) with

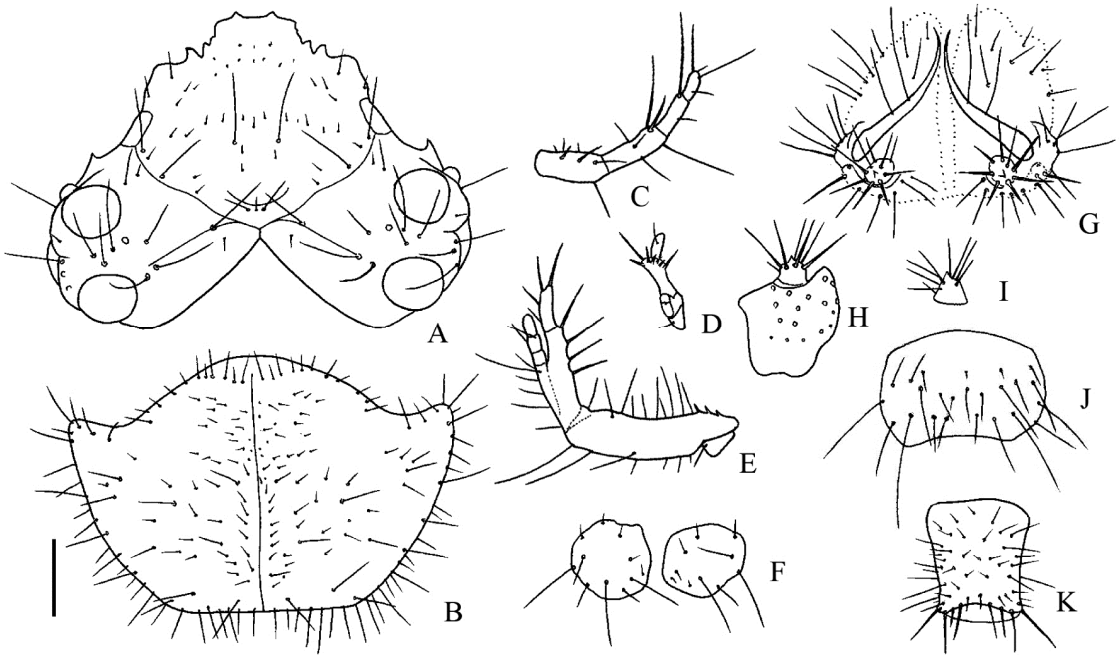

Fig. 28. *Abroscelis anchoralis punctatissima*: 3rd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (right, ventral view); E) maxilla (right, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook and posterior sclerite (right, caudal view); I) inner hook (left, lateral view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

5 pairs of setae on caudal margin.

Instar II (n = 5)
Collecting locality:
TAINAN City: Qigu Dist, Shifen Vlg, Dingtou-e sandbank, 27 X 2003 (1 field collection).
HSINCHU City: Xiangshan Dist, Haishangu, 20 IX 2010 (1 field collection), 27 VI 2013 (1 field collection). Xiangshan Dist, Nangang Vlg, 27 VI 2011 (2 field collections).

Coloration: Head light brown with reflection; mandible yellowish brown at base, apical half dark brown; antennae light brown, distal segment brown; pronotum light brown with green luster, anterolateral angles, narrow lateral margins and caudal margin creamy white; setae on head and pronotum slightly transparent white, setae on abdomen light brown.

Head (Fig. 29A): U-shaped ridge on frons with 2 or 3 setae; antennae (Fig. 29C), antennomere I and II each with 6-7 setae, length ratio of antennal segments = 1.00 : 1.07 : 0.70 : 0.49; maxillae (Fig. 29E), length ratio of maxillary palpomeres = 1.00 : 2.00 : 2.90, galeomere I with 3 (rare 2) setae on inner margin apically, length ratio of galeae = 1.00 : 0.58.

Pronotum (Fig. 29B): Surface intermixed with 7-8 long and more than 20 short setae on each half.

Abdomen: Tergite III (Fig. 29F) with 6-10 setae; tergite V (Fig. 29G), anterior sclerites with 11-13 setae, lateral sclerites with 3-4 setae, posterior sclerites with 11-16 setae; two pairs of hooks present, median hooks arched with 2 setae on middle part; inner hooks (Fig. 29H) conical with a ring made-up by 7-9 setae on shoulder and a central spine; posterior

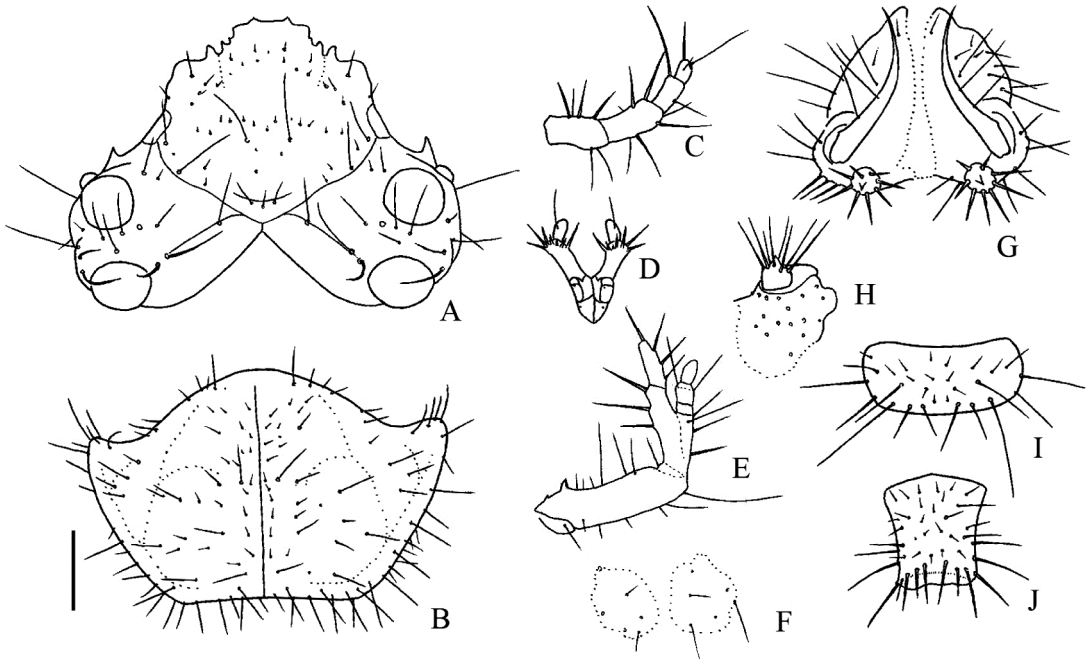

Fig. 29. *Abroscelis anchoralis punctatissima*: 2nd instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) inner hook and posterior sclerite (right, caudal view; I) tergite IX (dorsal view); J) pygopod (dorsal view). [scale bar = 0.4 mm].

margin of tergite IX (Fig. 29I) with 4 pairs of setae; pygopod (Fig. 29J) with 8-9 setae on caudal margin.

Instar I (n = 4)
Collecting locality:
TAINAN City: Qigu Dist, Shifen Vlg, Dingtou-e sandbank, 27 X 2003 (1 field collection).
HSINCHU City: Siangshan Dist, Haishangu, 7 X 2010 (1 field collection). Xiangshan Dist, Nangang Vlg, 27 VI 2011 (2 field collections).

Coloration: Head brown with luster; mandible yellow at base, apical half pale yellowish brown; antennae light brown, the distal segment darkened; pronotum pale brown, anterolateral angles, lateral margins and caudal margin creamy white; setae on head and pronotum transparent white, setae on abdomen light brown.

Head (Fig. 30A): Antennae (Fig. 30C), antennomere II with 3 setae, length ratio of antennal segments = 1.00 : 1.21 : 0.80 : 0.70; maxillae (Fig. 30E), length ratio of maxillary palpomeres = 1.00 : 2.42 : 4.50, length ratio of galeae = 1.00 : 0.58.

Pronotum (Fig. 30B): Surface with 7 long setae on each half.

Abdomen: Tergite III (Fig. 30F) with 4 setae; tergite V (Fig. 30G, H), anterior sclerites with 4-6 setae, lateral sclerites with 1 seta; two pairs of hooks present, median hooks arched with 1 seta on middle part; inner hooks (Fig. 30I) with an arc made-up by 5 setae on shoulder and a distinct central spine; posterior margin of tergite IX (Fig. 30J) with 3 pairs of setae; pygopod (Fig. 30K) with 3 pairs of setae on caudal margin.

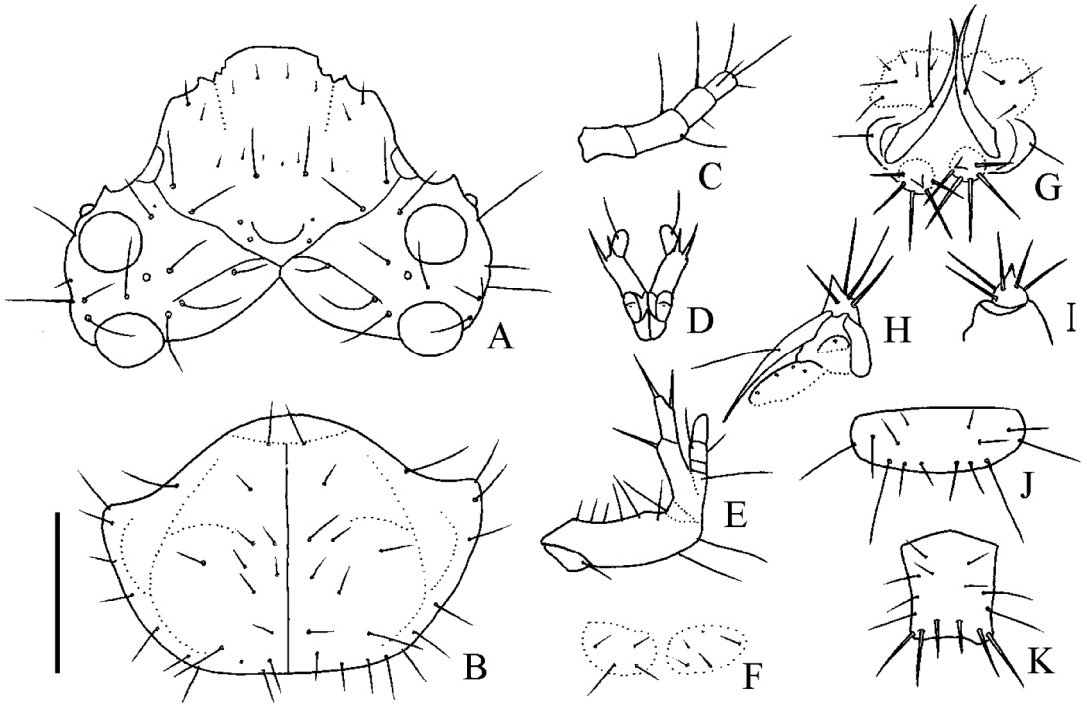

Fig. 30. *Abroscelis anchoralis punctatissima*: 1st instar larva: A) head (dorsal view, appendage removed); B) pronotum (dorsal view); C) antenna (left, ventral view); D) labium (ventral view); E) maxilla (left, ventral view); F) tergite III (dorsal view); G) tergite V (dorsal view); H) tergite V (left, lateral view); I) inner hook (left, caudal view); J) tergite IX (dorsal view); K) pygopod (dorsal view). [scale bar = 0.5 mm].

Pupa (n = 1)
Collecting locality:
HSINCHU City: Xiangshan Dist, Nangang Vlg, 23 VI 2013

Figure: Length = 7.1 mm; compound eyes light brown; antennae pale brown, except scape pale yellow; mandible pale yellow at base, serration black; dorsal segments creamy yellow; elytra creamy yellow; tergite spurs yellow; setae of spurs pale brown; tergites I-V with paired dorsal spurs; length of spurs IV = 0.50 mm, apex of spurs I-IV with 4 setae; length of spurs V = 0.75mm, apex of spurs V (Fig. 31) with a ring made-up by 7-9 setae.

Habitat: Adults and larvae were collected from moist sand flats just above the high tide level or from the salty pool edge between dunes near the sea shore.

Note: The distribution of this subspecies is mainly on the western coast and some sites of the eastern coast, and is more widespread than *A. a. anchoralis*. It would be interesting to find out the

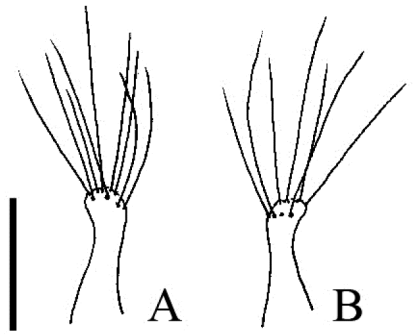

Fig. 31. *Abroscelis a. punctatissima*: pupa: A) apex of spur V (left); B) apex of spur V (right) [scale bar = 0.4 mm].

distributional limits between these two subspecies.

Acknowledgment

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

Species	Collecting sites
T. alboobliquatus alboobliquatus	MIAOLI County: Nanzhuang Township 南庄, Jiali Mt 加里山 (24°31'20",120°00'42").
L. cancellata subtilesculpta	CHIAYI County: Yizhu Township 義竹, Guoluzih 過路子 (23°18'05",120°11'19").
L. striolata dorsolineolata	TAICHUNG City: Taichung Metropolitan Park 台中都會公園 (24°12'20",120°15'10").
Cy. psilica	NANTOU County: Lugu Township 鹿谷, Waicheng 外城 (23°48'24",120°45'52").
C. elisae reductelineata	YILAN County: Nanao Township 南澳, Hanben 漢本, Heping river estuary 和平溪口 (24°18'50",121°46'15").NANTOU County: Renai Township 仁愛, Chunyang 春陽 (24°01'31",120°09'59"). Shueili Township 水里, Shueili river confluence 水里溪匯流處 (23°48'46",120°50'46"). HUALIEN County: Fongbin Township 豐濱, Dagangkou 大港口 (23°28'00",121°29'44"). Sioulin Township 秀林, Heping river estuary 和平溪口 (24°18'45",121°45'39"). Heping river 和平溪 alt.140m (24°20'53",121°39'52").CHIAYI County: Zhongpu Township 中埔, Haoshouzhuang 好收庄, Bazhang riverside 八掌溪岸 (23°27'09",120°29'26").
A. anchoralis anchoralis	NEW TAIPEI City: Gongliao Dist 貢寮, Yenliao 鹽寮 (25°02'23",121°55'21").
A. anchoralis punctatissima	HSINCHU City: Xiangshan Dist 香山, Haishangu 海山罟 (24°45'34",120°53'34"). Xiangshan 香山 Dist, Nangang 南港 (24°44'41",120°52'59"). TAINAN City: Qigu Dist 七股, Shihfen Vlg 十份, Dingtou-e sandbank 頂頭額沙洲 (23°04'37",120°01'47")

台灣產虎甲蟲幼生期描述（II）

林宗政

行政院農業委員會特有生物研究保育中心　55244 南投縣集集鎮民生東路 1 號

摘　要

描述台灣產 7 種虎甲蟲的幼生期，其中多斑虎甲蟲 *Lophyra cancellata subtilesculpta*、小八星虎甲蟲 *Cylindera psilica* 與暗紋虎甲蟲 *Cylindera elisae reductelineata* 等 3 種有包含卵、幼蟲至蛹的完整描述，*Abroscelis anchoralis anchoralis* 及錨紋虎甲蟲 *Abroscelis anchoralis punctatissima* 則描述除了卵之外的幼生期各階段，而斜紋突眼虎甲蟲 *Therates alboobliquatus alboobliquatus* 與縱紋虎甲蟲 *Lophyra striolata dorsolineolata* 則為卵至 3 齡幼蟲的描述。除此，並附上幼蟲棲地與成蟲生態的簡短資料。

關鍵詞：虎甲蟲科、虎甲蟲、幼蟲形態、分類、台灣。

*論文聯繫人
Corresponding email: llliinnn@tesri.gov.tw