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Description of Immature Stages of *Colletes esakii* (Hymenoptera, Colletidae)[1)]

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Abstract. Immature stages (egg, mature larva and pupa) of *Colletes esakii* Hirashima are described. Morphology of the mature larva is compared with that of the other species in the genus.

Key words: Hymenoptera, Colletidae, *Colletes,* morphology, egg, mature larva, pupa.

Introduction

We discovered a dense nesting aggregation of *Colletes esakii* Hirashima (1958) at the foot of Mt. Adachi, Kitakyushu City, Fukuoka Pref., Japan, in August 2001, and have been studying the nesting biology and immature stages of this species since 2002.

This species was described by Hirashima (1958), based on the female specimens collected from Amami-Oshima Is., Japan, and has been subsequently found in several places in central and western Honshu (Ikudome 1989). This is the first record of this species from Kyushu.

In this report, we describe the immature stages (egg, mature larva, pupa) of this species. The immature stages of 12 species of *Colletes* have been treated by other authors worldwide: *C. ciliatoides* Stephen (1954), *C. daviesanus* Smith (1846), etc. (McGinley 1989). Recently, the taxonomic studies of immature stages of bees have been contributed to phylogenetic dis-

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cussion. In Colletidae, McGinley (1981) investigated the phylogenic relations of the family based on the mature larvae and demonstrated that information concerning immature stages is important in understanding the phylogenic relations of bees. As to the immature stages of the Japanese *Colletes*, only a sketch of the pupa of *C. babai* Hirashima et Tadauchi (1979) was shown by Goukon (1982). We describe the detailed morphology of immature stages of *C. esakii* in this paper, and compare the mature larva of *C. esakii* with the larvae of two North American species, *C. thoracicus* Smith (1853), *C. fulgidus* Swenk (1904), that were sufficiently described and illustrated for this purpose.

Material and Methods

The eggs, larvae and pupae used in the present study were specimens collected at Mt. Adachi, Kitakyushu City, Fukuoka Pref., Japan. They are illustrated in lateral and dorsal views. After that the head was drawn in frontal and lateral views, it was cut from the body, cleared in a boiling solution of 10% KOH, and then immersed in glycerine on a slide glass. Illustrations of the head are modified so that internal ridges are depicted and fine details of spiculation and sensilla added with the aid of both an Olympus stereo-microscope and a Nikon phase-contrast microscope. Afterward the right mandible was pried from the head and drawn in three views. Spiracles were cut from the right side of the larva, cleared in boiling KOH, and kept on the same slide glass with the head and mandible. The pupa is illustrated in lateral, dorsal and ventral views.

The terminology used in this paper follows Michener (1953, 1954), Rozen & McGinley (1974), and Rozen (2001).

Description

Egg (Fig. 1)

Length: 1.6-1.8 mm; diameter: 0.4-0.6 mm (n = 4).

The egg is elongate, gently curved, translucent white and shiny.

Mature larva

Postdefecating larva (prepupa) (Figs. 2-8)

Body length: 7.8-10.8 mm (n = 10).

Head (Figs. 3, 4): Head capsule wider than long measured from top of vertex to level of lower margin of clypeus as seen in frontal view; vertex in lateral view rounded, not projecting; parietal bands long, very faint; frontal swelling above antennae absent; antennal prominence scarcely developed; antennal papilla small, bearing 3 sensilla; antennal disc large, ring-like; postoccipital ridge weak, virtually absent medially; posterior tentorial pit located at junction

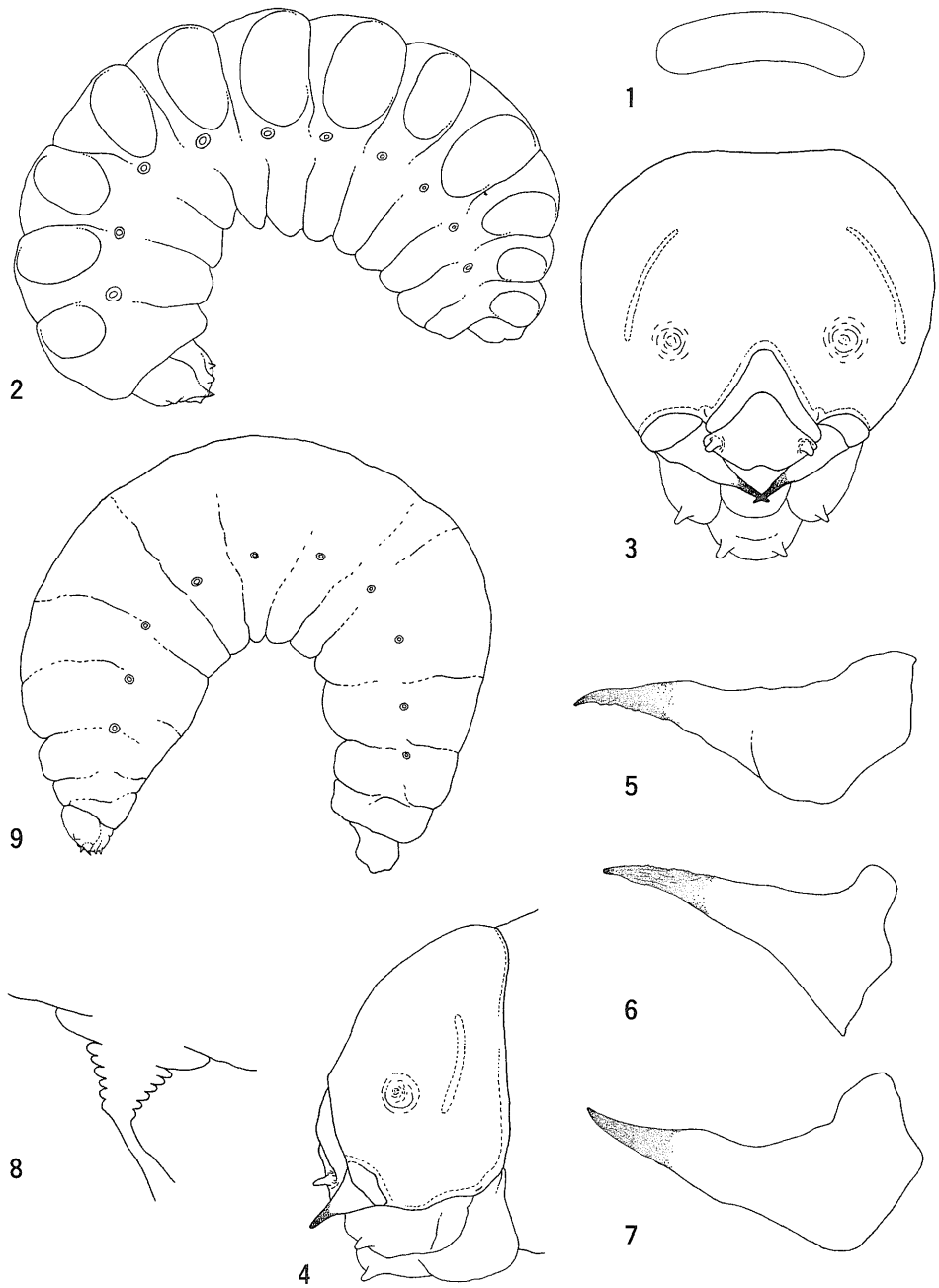


Fig. 1. Egg in lateral view.
Figs. 2-9. Mature larvae (2-8: postdefecating larva; 9: predefecating larva). 2, 9: entire body in lateral view; 3, 4: head (3: frontal view; 4: lateral view); 5-7: mandible (5: dorsal view; 6: inner view; 7: ventral view); 8: spiracle in lateral view.

of hypostomal ridge and postoccipital ridge (but located somewhat posterior to postoccipital ridge); hypostomal ridge weak, somewhat narrow; pleurostomal ridge developed; epistomal ridge weak; clypeal form crescentic; anterior tentorial pit conspicuous, immediately adjacent to the anterior mandibular articulation; labrum nonspiculate, weakly projected in lateral view, anterior margin of labrum bilobed in frontal view; labral tubercles elongate, apically rounded. Mandible (Figs. 5-7) moderate in length; dorsal mandibular spiculation absent; outer surface of mandible smooth, tubercles and setae absent; cusp not defined; apical portion of mandible moderately attenuate, dorsal apical edge serrate; apical concavity indistinct; ventral apical edge without serrations. Hypopharynx round, hypopharynx groove distinct, not sclerotized; maxilla nonspiculate; maxillary palpus elongate, apically round; labiomaxillary region moderately recessed in lateral view; labium divided into prementum and postmentum in lateral view; salivary opening transverse, moderately broad, without projecting lips; labial palpus elongate, nearly as large as maxillary palpus.

Body (Figs. 2, 8): Body form robust, integument nonspiculate; intersegmental lines deeply incised; intrasegmental lines indistinct; dorsolateral tubercles large though broad and rounded, extending downward nearly to the level of the spiracles; abodominal segment X in lateral view, attached dorsally to segment IX, venter of segment X not projecting, conspicuous spiculation absent, dorsal surface of segment X smooth, ridges and lines absent; anus slightly dorsal in position. Spiracles (Fig. 8) large, not elevated; atrium broad and shallow, not produced above body surface; atrial spines absent; rim absent; peritreme wide; primary tracheal opening without collar; subatrium short, with 6 chambers.

Predefecating larva (Fig. 9)

Body length: 10.8-12.6 mm (n = 2).

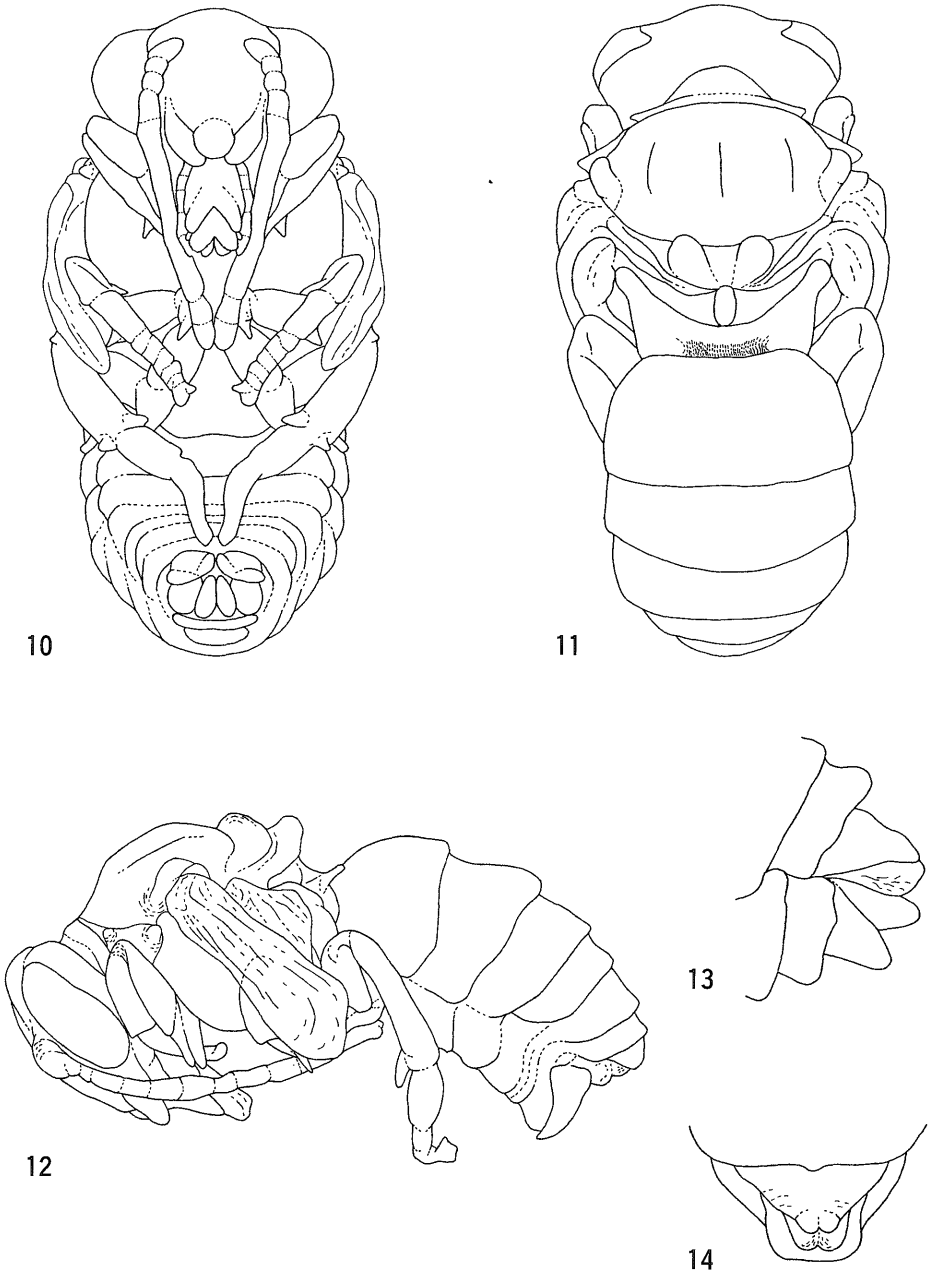
Head, mandible, spiracle characters are similar to the postdefecating larva described above except as follows; intersegmental lines faint (deeply incised in postdefecating larva); dorsolateral tubercles scarcely developed (developed in postdefecating larva).

Remarks: This species is distinguished from *C. fulgidus* by the following morphological characters: antennal prominence scarcely developed; epistomal ridge weak; ventral apical edge of mandible without serrations; subatrium of spiracle with 6 chambers (*C. fulgidus* with many chambers). This species is distinguished from *C. thoracicus* by the following morphological characters: hypostomal ridge weak; pleurostomal ridge developed; epistomal ridge weak; labrum with sensilla-bearing swelling mesiad of each labral tubercle absent; ventral apical edge of mandible without serrations; hypopharynx nonspiculate.

Pupa (Figs. 10-14).

Body length: female: 11.2-11.6 mm (n = 2); male: 7.4-10.9 mm (n = 12).

Body without setae; lateral angles of pronotum and posterior lobes of pronotum produced;



Figs. 10-14. Pupae (10-12: male pupa; 13, 14: female pupa). 10: vetral view; 11: dorsal view; 12: lateral view; 13, 14: distal metasomal sterna (13: lateral view; 14: ventral view).

mesoscutellum with pair of large tubercles; metanotum with large median tubercle; all coxae each with moderate sized apical spine; fore trochanter with long spine, middle and hind trochanters each with small spine; fore and middle femora each with moderate-sized spine, hind femur without spine; all tibiae each with moderate-sized spines apically. Female and male pupae are easily separated by distal metasomal sterna.

Specimens examined: Mt. Adachi, Kitakyushu, Fukuoka Pref., Japan: 4 eggs, 6. viii. 2003; 17 postdefecating larvae, 4. xii. 2002; 2 predefecating larvae, 15. viii. 2002; 12 pupae, 10. iv. 2003 (reared from larvae collected on 4. xii. 2002), 2 pupae, 27. vii. 2003.

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