

Hymenopteran parasitoids associated with the banana-skipper *Erionota thrax* L. (Insecta: Lepidoptera, Hesperiiidae) in Java, Indonesia

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ABSTRACT

Erniwati, Ubaidillah R (2011) Hymenopteran parasitoids associated with the banana-skipper *Erionota thrax* L. (Insecta: Lepidoptera, Hesperiiidae) in Java, Indonesia. *Biodiversitas* 12: 76-85. Hymenopteran parasitoids of banana-skipper *Erionota thrax* L. (Insecta: Lepidoptera, Hesperiiidae) from Java, Indonesia are reviewed and an illustrated key to 12 species is presented to include *Theronia zebra zebra*, *Xanthopimpla gamsura*, *Casinaria* sp., *Charops* sp., *Cotesia (Apanteles) erionotae*, *Brachymeria lasus*, *B. thracis*, *Ooencyrtus pallidipes*, *Anastatus* sp., *Pediobius erionotae*, *Agiommatius sumatraensis* and *Sympiesis* sp. The surveys of the natural enemies of the banana-skipper were conducted in 1990-2006 in several localities in Java. The aim of this study was to assess the native natural enemies of *E. thrax*, especially the parasitic Hymenoptera. Infested eggs, larvae and pupae of *E. thrax* were collected and reared in the laboratory. Emerging parasitoids were preserved in both dry mounting and in 80% alcohol for the species identification. Members of families Braconidae, Ichneumonidae, Encyrtidae, Pteromalidae, Chalcididae, Eupelmidae and Eulophidae were recorded as parasitoids of the banana skipper *E. thrax* from Java, Indonesia. Species distribution and alternative hosts of the parasitoids are presented.

Key words: Hymenoptera, parasitoids, banana skipper, *Erionota thrax*, identification key, distribution.

INTRODUCTION

Erionota thrax L. was classified as a minor pest in Indonesia (Kalshoven 1951), however, very serious infestation occasionally occurs in Java. The pest has also caused economic damage to bananas in new banana plantations in Papua New Guinea (Sands et al. 1991). This study was initially conceived in conjunction with cooperative project in the title “*Speciation and population dynamics of insect pests of crops in Indonesia: a basic study for integrated pest control*” among Kanazawa University, Hokkaido University and Bogor Zoology Museum in 1992 in Java, Indonesia (Nakamura and Katakura 1992; Matsumoto et al. 1995). The project goal was to understand the seasonal population dynamic of major pest in tropical Indonesia, includes banana-skipper *E. thrax*. Eventually, the research expanded to document the identities of parasitoids on banana-skipper not only in Java but also in other islands of Indonesia. There have been a few studies on banana-skipper, *E. thrax* in Indonesia e.g. Kalshoven (1951), especially on its natural enemies. The parasitoids of *E. thrax* from West Java were studied for the first time by Ashari and Eveleens (1974) who reported 94% of eggs, larvae and pupae were killed by six species of parasitoids. Hasyim et al. (1994) and Hasyim et al. (1999) have reported 14 species of parasitoids which occur in Sumatra including dipteran parasitoids. Okolle et al. (2006) have reported five primary endoparasitoids were recorded: *Ooencyrtus erionotae* Ferriere, *Cotesia erionotae* Wilkinson, *Brachymeria albotibialis* Hoffmann, *Elasmus*

sp. and *Melaloncha* sp. The first of three species were, respectively, the major egg, larval and pupal parasitoids.

Hymenopteran parasitoids are very important as biological control agents of various agricultural pests and are thus responsible for the sustainable agriculture. The superfamilies Ichneumonoidea and Chalcidoidea are among the largest assemblages within Parasitica. Members of these superfamilies are parasitoids of economically importance insect-pest and have been heavily used in many classical biological control programs (LaSalle 1993).

The objectives of this study were to identify the Hymenopteran parasitoids of *E. thrax* occurring in Java, record their distribution and better understand their biology. This is the first step towards recording the comprehensive parasitic hymenopteran fauna of *E. thrax* from Java. This paper will present the faunal make up and distribution of parasitic hymenoptera associated with *E. thrax*, including some new parasitic records from this island. An illustrated key to species is presented and each species is discussed.

MATERIALS AND METHOD

The study was carried out in three main provinces of Java Island, between 1990 to 2006. Sixteen localities were selected respectively West Java (Cimanglid, Cimanggu, Sukaraja, Bogor Botanic Garden, Pagelaran, Sindangbarang, Ciomas, Tipar, Cigaru, Tajur-Cianjur), Central Java (Karimunjawa, Wonogiri, Purworejo), and

East Java (Purwodadi, Pasuruan, Southern Malang) to include different climatic and geographic conditions. Samples were collected in dry and wet seasons depending on the time availability. Each locality was sampled intensively when we visited the locality. The material was collected by hand collecting from different banana plantation systems both wild grown and cultivated bananas. Every banana leaf, especially the undersides, was observed carefully to find eggs, larvae, and pupae of banana skipper. All eggs, larvae, and pupae found were then removed from the leaf to plastic bag using scissors or hand picked. All eggs, larvae, and pupae are then transferred into a small plastic container in which only one specimen placed in each container. The plastic containers or plastic cups were all kept in the rearing room with the room temperature of 27-30°C, and 80% relative humidity. The size of culture plastic cups was 12 cm in diameter and 9 cm in height. Any parasitoids emerged from the eggs, larvae, and pupae were then killed by ethyl acetate and were removed into vials with 70% alcohol inside.

Representative specimens were mounted as pinned specimens, and the minute specimens (less than 5 mm) were mounted on the rectangle card (Noyes 1982). The specimens were then examined under light stereo microscope (Olympus, SZX 12). Hand drawings of the specimens were prepared by second authors (RU) with the help of camera lucida and the required measurements were obtained by means of a calibrated ocular micrometer. The voucher specimens are deposited in Entomology Laboratory Museum Zoologicum Bogoriense (MZB), Research Center for Biology, Indonesian Institute of Sciences, Cibinong Bogor, West Java.

RESULTS AND DISCUSSION

Twelve species of hymenopteran parasitoids were collected from the eggs, larvae, and pupae of *E. thrax*. Their number and relative abundance of parasitoid species, are given in Table 1. Five species of the parasitoids found in this investigation are members of the superfamily Ichneumonoidea and the remaining seven are members of the superfamily Chalcidoidea. All of the parasitoids reared from the eggs, larvae, and pupae of the *E. thrax* in Java were documented for the first time. Hasyim et al. (1999) recorded 12 species of hymenopteran parasitoids from Sumatra, in which one species in their list, *Elasmus* sp. was not found in Java, meanwhile one species *Sympiesis* that was found in East Java had not been recorded in Sumatra.

Those parasitoids have been known to be economically important

species. Five species, namely *Sympiesis* sp., *Agiommatus sumatraensis* Crawford, *Charops* sp., *Casinarina* sp., *Brachymeria thracis* Crawford, are recorded for the first time from Java. There are a large number of specimens (i.e. about 347 specimen) from eggs (103 specimens), larvae (59 specimens), and pupae (185 specimens). The samples collected in Java undoubtedly indicate the richness of parasitoids on our agro-ecosystem. These data can play an important role in the biological control programs of the banana-skipper.

Four species are known to infest eggs of skippers, i.e. *Ooencyrtus pallidipes* of the family Encyrtidae, *Agiommatus sumatraensis* Crawford of Pteromalidae, *Pediobius erionotae* Kerrich of Eulophidae, and *Anastatus* sp. of Eupelmidae. The last species was mistakenly included in the family of Encyrtidae by Hasyim et al. (1994) has also noted that *Oo. erionotae* Ferrie (1931) infested the egg of *E. thrax* in Sumatra, however, the species had been synonymized to *Oo. pallidipes* Asmead (1904) by Noyes and Hayat (1984). The *P. erionotae* which was reared from the eggs of *E. thrax* are known to be hyperparasitoids of *Catesia erionotae* Noyes (2002).

Four species of parasitoids were found to infest larvae of skippers, i.e. *Sympiesis* sp. of Eulophidae that was specifically emerged from very early stage of larvae (L2). This species most probably belong to undescribed species and it is only found from East Java. The braconiid, *Cotesia (Apanteles) erionotae* Wilkinson emerged from the larvae in fourth and fifth instar stage, however ichneumonid species, *Charops* sp. and *Casinarina* sp. emerged in thirds and fourth instar stage. Four species of parasitoids were recorded from pupae of skippers. two species belong to the

Table 1. List of natural enemies of *Erionota thrax*, host stages and their distributions in Java

Family/species	Host stages	Distributions		
		West Java	Central Java	East Java
Ichneumonidae				
<i>Theronia zebra-zebra</i> Vollenhoven	Pupa	+	-	+
<i>Xanthopimpla gampsura</i> Krieger	Pupa	+	+	+
<i>Casinarina</i> sp.	L3,L4 L3,L4	+	-	+
<i>Charops</i> sp.	L3,L4 L3,L4	+	-	-
Braconidae				
<i>Cotesia Apanteles erionotae</i> Wilkinson	L4,L5	+	+	+
Chalcididae				
<i>Brachymeria lasus</i> Walker	Pupa	+	+	+
<i>Brachymeria thracis</i> Crawford	Pupa	+	-	+
Encyrtidae				
<i>Ooencyrtus pallidipes</i> Ashmead	Egg	+	-	-
Eupelmidae				
<i>Anastatus</i> sp.	Egg	-	-	+
Eulophidae				
<i>Pediobius erionotae</i> Kerrich	Egg	+	+	+
<i>Sympiesis</i> sp.	L2	-	-	+
Pteromalidae				
<i>Agiommatus sumatraensis</i> Crawford	Egg	+	+	+

Note: L1...5 = stage of larva, + = present, - = absent

family of *Ichneumonidae*: *Xanthopimpla gampsura* Krieger and *Theronia zebra-zebra* Vollenhoven, and two others belong to the family of *Chalcididae*: *Brachymeria lasus* Walker and *B. thracis* Crawford. *B. lasus* was known to be hyperparasitoids of *Casitaria* sp. (Hasyim et al. 1994; Noyes 2002).

Key to Javanese species of parasitoids Hymenoptera of *Erionota thrax*

Having known adequate important characters, we tried to construct suitable keys of the adult parasitoids including line drawing to show the habitus and the characters. The key is intended to identify the superfamily, family, and genera in which the species belong to. The following key and the diagnostic characters on the text for each species may prove helpful to recognise the twelve species.

1. Forewing with numerous veins and there are three or more closed cells (Figure 1a); 1st abdominal segment inserted high up on propodeum (= posterior part of thorax which is actually 1st abdominal segment) so that distance between propodeal socket and insertion of hind coxa is ca. equal to or greater than distance between socket and hind margin of metanotum; antennae usually filiform (= thread-like), unspecialized, with 18 or more segments; forewing with costal cell indistinct or absent, veins C, Sc, R and Rs fused between wing base and pterostigma (= opaque spot along costal wing margin) (Figure 1a); sternites of abdomen weakly sclerotized (= hardened); solitary larval parasitoids
..... (Ichneumonoidea) 2

Forewings with reduced venation and without enclosed cells (Figs. 1c and 1d); some metallic species; Abdomen usually cylindrical; antennae with various numbers of segments, if with 14 segments in female and of 13-segments in male then ovipositor exposed or antennae attached to a shelf-like process of the face; cerci present; ovipositor opening terminal segments
..... (Chalcidoidea) 6

2. Vein RS+M absent (Figure 1a: arrow A), vein 2m-cu present (Figure 1a: arrow B)
..... (Ichneumonidae) 3

Vein RS+M present (Figure 1a: arrow A), vein 2m-cu absent (Figure 1a: arrow B)
... Figure 4a (Braconidae) *Cotesia erionatae* Wilkinson

3. Forewing with 2m-cu with two separate bullae (Pimplinae) (Figure 1b: arrow B) 4

Forewing with 2m-cu with a single bulla (Figure 1a: arrow A) 5

4. Mandible strongly tapered, twisted; labrum exposed when mandible closed; clypeus transverse and entire; malar space shorter than basal mandibular width. Forewing with 3r-m present, with bigger enclosing

semi-triangle areolet, hindwing with first abscissa of *Cu1* about 0.3 times length of *Cu-a*. Gaster usually polished, often punctate, colour yellow with marked black spots
..... Figure 2b. *Xanthopimpla gampsura* Krieger

Mandible only moderately tapered, not twisted; labrum concealed when mandible closed; clypeus elongate. Forewing with 3r-m present, with small enclosing rhombic areolet; hindwing with first abscissa of *Cu1* about 0.3 times length of *Cu-a*. Propodeal spiracle elliptical; propodeum dorsally with lateral longitudinal and lateromedian carinae discernible. Gaster with tergite one rather slender
..... Figure 2a. *Theronia zebra-zebra* Vollenhoven

5. Forewing with 3r-m absent, *cu-a* subvertical, 2r-m longer than abscissa of *M* between 2r-m 2m-cu; hindwing with distal abscissa of *Cu1* obsolescent, *Cu-and cu-a* sloping inwards posteriorly. Gaster with first segment very slender and long; clepeus convex with impressed marginally; mandible short, with a broad ventral flange on basal
..... Figure 3b. *Charops* sp.

Forewing with 3r-m present, areolate petiolate, 2-m-cu joining slightly to center, marginal cell long; hindwing with distal abscissa of *Cu1* absent. Gaster with first segment long, petiole slender, compressed
..... Figure 3a. *Casitaria* sp.

6. Fore, mid and hind tarsi with 4 segments 7

Fore, mid and hind tarsi with 5 segments 8

7. Scutellum with one pair of setae; forewing hyaline, submarginal vein with 2 dorsal setae and the vein strongly tapering at apex, not smoothly joining the parastigma; stigmal vein short, the postmarginal vein shorter than stigmal vein and very difficult to see (Figure 7a); gena very short; flagellum very short; body length about 1.1 mm
..... Figure 7a. *Pediobius erionotae* Kerrich

Scutellum with two pair of setae; forewing hyaline, submarginal vein with 6 dorsal setae and the vein not tapering at apex, smoothly joining the parastigma; stigmal relatively long, the postmarginal vein longer than stigmal vein; gena relatively long; flagellum relatively long; body length about 2.0 mm
..... *Sympiesis* sp.

8. Hind femur strongly enlarged and with teeth on ventral edge (Figure 5b and 5d), gaster convex; gena posteriorly with strong carina; prepectus very small and tegula only slight longer than broad; body black with yellowish or whitish marking at hind legs.
..... (Chalcididae) 9

Hind femur normal not strongly enlarged (Figure 5b and 5d), gaster not convex; gena posteriorly without

strong carina; prepectus relatively large at least as broad as the tegula; body black or metallic, without yellowish or whitish marking at hind legs 10

9. Antenna swollen toward apex and tapering on the tip (Figure 5c); Hind femur black with apex yellow; hind tibia black with distinct subbasal and apical yellow patches (Figure 5d); apex of scutellum emarginate *Brachymeria thraxis* Crawford

Antenna not swollen toward apex and rounded on the tip (Figure 5a); Hind femur black with apex yellow; hind tibia yellow with the base black (Figure 5b); apex of scutellum weakly emarginate and slightly rounded Figure 4b *Brachymeria lasus* Walker

10. Mesopleuron greatly enlarged, convex, transformed into a large undivided shield posterior margin of prepectus often loose and thin; spur of mid tibia often large and hairy 11

Mesopleuron not enlarged, slightly concave medially, not transformed into a regular shield and ventrally with distinct transverse crest before mid coxa; prepectus thin, not loose posteriorly; spur of mid tibia normal. Eye very large, with inner orbits strongly diverging downwards; female antenna with 3 anelli, flagellum relatively short, body colour blackish metallic Figure 7b
(Pteromalidae) *Agiomatus sumatraensis* Crawford

11. Antenna with nine segments flagellomere, anelli one segment very small mid coxa not quite closed to hind one; mesoscutum convex and short; axillae transverse, often meeting in midline; forewing with submarginal vein very long, marginal vein very short and much shorter than stigmal vein
Figure 6a (Encyrtidae) *Ooencyrtus pallidipes* Ashmead

Antenna with eight segments flagellomere plus clava; mid coxa much nearer to hind coxa than to fore ones; mesoscutum with notaular depressions; axilla not strongly transverse and mostly wide apart so that scutellum not pointed anteriorly; hind wing with submarginal vein shorter than marginal vein, marginal vein much longer than stigmal vein
..... Figure 6b (Eupelmidae) *Anastatus* sp.

Description

Family Ichneumonidae

Genus *Theronia* Holmgren (1859)

Species *Theronia zebra-zebra* Vollenhoven (1879) (Figure 2a).

Pimpla zebra Vollenhoven (1879: 133), type species *Pimpla zebra* Vollenhoven (1879); *Orientotheronia maculipes* Morley (1913: 531), type species *Orientotheronia maculipes* Morley (1913), synonymized

with *Theronia zebra* by Morley (1914), transferred to *Theronia zebra* by Narayanan and Lal (1953: 319); *Theronia callida* Tosquinet (1903: 1), type species *Theronia callida* Tosquinet (1903), synonymized with *Theronia zebra* by Roman (1913: 1); *Theronia maskeliyae* Cameron (1905: 67), type species *Theronia maskeliyae* Cameron (1905), synonymized with *Theronia zebra* by Meade-Waldo and Morley (1914: 402).

Diagnosis. This species can be easily distinguished by the following characters: body length about 12 mm; wing hyaline, stigma dark brown, forewing length about 11 mm; clypeus smooth, with margin slightly concave; frons smooth, with small carina between antennal sockets and with conspicuous black mark near antennal socket; mesoscutum with notauli hardly indicated; scutellum slightly convex; all body markings are black instead of rufous or rufous and black.

Biology. This species is also known to be the parasitoids of pupa *Atrophaneura alcinous mansonensis*; *Atrophaneura polyeuctes termessus*; *Attacus atlas*; *Caligula japonica*; *Cricula trifenestrata*; *Cricula trifenestrata javana*; *Cryptothelea minuscula*; *Delias belisama*; *Dendrolimus punctatus*; *Eriogyna pyretorum*; *Euploea leucostictos hobsoni*; *Hidari irava*; *Hyblaea puera*; *Lymantria serva*; *Olene mendosa*; *Parnara guttata*. This wasp was recorded mainly from West Java and a few specimens were recorded from East Java.

Specimens examined. West Java: 3, 6, MZB, Bogor, Kedung Halang, Sukaraja, 26.iii.1996, 250 m asl., Erniwati, ex. pupa *E. thrax*;

Distribution. Indonesia: Java; India; China: Fujian, Guangdong, Guangxi, Guizhou, Hong Kong, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang; Japan: Okinawa; Myanmar; Vietnam; Thailand; Malaysia; Singapore. Gupta (1962) regarded that this species was described in 1879 from the type specimen collected from Ambarawa, Central Java and later in 1892 Peiper collected some more specimens from Sukabumi, those all reared from *E. thrax*, however (Tjoa 1939) collected two specimens from Bogor, both male and female reared from *Cricula trifenestrata*.

Genus *Xanthopimpla* Saussure (1892)

Xanthopimpla gampsura Krieger (1914) (Figure 2b)

Xanthopimpla gampsura Krieger (1914: 1), type species *Xanthopimpla gampsura* Krieger (1914), lectotype by (Townes et al. (1961) female, South Borneo, deposited in Berlin; *Xanthopimpla gampsura* Tjoa (1939: 501), Java: Sarapoh, West Borneo, host: *Hidari irava*, synonymized by Townes et al. (1961: 56); *Xanthopimpla gampsura* Kalshoven, Sody and Bommel (1951: 654), host: *Hidari irava*, synonymized by Townes et al. (1961: 56).

Diagnosis. Among the *Xanthopimpla* complex, the species can be easily recognized by the black body color and yellow stripes on head and thorax, and the abdomen is yellow with marked black spots, the end part of the abdomen is brownish red. Body length about 6.5 mm; clypeus divided into basal and apical parts by transverse suture, clypeal margin transverse; mandible strongly twisted about 90°, slightly narrowed. The antennae are very

long (Figure 2b). These diagnostic characters above are partly taken from Gauld (1984) and Gupta (1987).

Specimens examined. West Java: 1, MZB, Bogor, Cimanglid, 20.vi.1996, 500 m asl, Erniwati, ex pupa *E. thrax*; 1, MZB, Bogor, Kedung Halang, Sukaraja, 21.v.1996, Erniwati, ex pupa *E. thrax*; Central Java: 1, MZB, Temanggung, Kedu, 28.iii.2005, 07°16'36.4 S 110°09'00.4 E, 680 m asl, S. Kahono, Erniwati, ex pupa *E. thrax*; East Java: 3, MZB, Purworejo, Bayan, Candisari and Dukuhrejo, 14.viii.2004, 07°43'36.7 S 109°57'42.8 E, 135 m asl, S. Kahono, Erniwati, Sarino, ex pupa *E. thrax*.

Distribution. Indonesia: Java, Kalimantan, Sumatra; Malaysia.

Biology. This species is known to be the parasitoid of Hesperidae pupa, i.e. *Cephrenes chrysozona*, *E. thrax*; and *Hidari irava*.

Casinaria Holmgren (1859)

Casinaria sp. (Figure 3a)

Diagnosis. Head slightly lenticular; clypeus weakly convex, broad, evenly arcuate, mandible short, with a broad flange on ventral margin that abruptly ends about two-third of way along mandible. Pronotum very short; scutellum weakly convex; mesopleuron with speculum distinct, polished and weakly sculptured; mesopleural suture relatively strong; propodeum long, evenly declivous, with a median longitudinal furrow, spiracle oval. First segment of the gaster long, petiole slender.

Specimens examined. West Java: 1, MZB, Bogor, Kedung Halang, Sukaraja, 23.iv.1996, 250 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Cipaku, 30.xii.1990, 400 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Parakan, 22.ii.1991, 250 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Curug Nangka, 28.ii.1991, 500 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Curug Nangka, 27.viii.1991, 500 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Sindangbarang, 12.xii.1990, 250 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Sindangbarang, 10.ii.1992, 250 m asl, Erniwati, ex larva *E. thrax*.

Distribution. Indonesia: Java (*new record*), Sumatra.

Biology. This species was reared from pupa of *E. thrax* (Lepidoptera: Hesperidae).

Charops Holmgren (1859)

Charops sp.1 (Figure 3b)

Diagnosis. This species has combination characters as follows: head lenticular; clypeus convex, margin impressed, evenly arcuate, mandible rather short, with a broad flange on ventral margin that abruptly ends about two-third of way along mandible. Pronotum very short; scutellum deplanate; mesoscutum iniformly reticulate; mesopleuron with speculum not differentiated; mesopleural furrow not distinctly impressed; propodeum moderately long, abruptly declivous, with fairly evenly reticulate, spiracle elliptical. Gaster with first segment very long and slender.

Specimens examined. West Java: 2, MZB, Bogor, Curug Nangka, 14.ii.1991, 500 m asl, Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Cipaku, 11.ii.1991, 400 m asl,

Erniwati, ex larva *E. thrax*; 1, MZB, Bogor, Kedung Halang, Sukaraja, 21.v.1996, 250 m asl. Erniwati, ex larva *E. thrax*; Central Java: 2, MZB, Wonosobo, Garung, Maron, PLTA, 19.vi.2007, 07°17'34 S, 109°55'16. E, 1100 m asl, R. Ubaidillah, Rofik, Gianto, sweeping net.

Distribution. Indonesia: Java (*new record*), Sumatra.

Biology. This species was reared from pupa of *E. thrax* (Lepidoptera: Hesperidae).

Family Braconidae

Genus *Cotesia* Cameron (1891)

Cotesia erionotae Wilkinson (1928) (Figure 4a)

Cotesia erionotae Wilkinson (1928), type species *Apanteles erionotae* Förster (1862: 225).

Diagnosis. Body blackish brown, length about 3.5 mm; length of forewing about 2.5 mm; antenna slender, about as long as body length; mesoscutum and scutellum coarsely punctuate; hind coxa slightly dull and rugose-punctate; metasomal tergites distally to basal area with yellowish brown, legs bright yellowish brown, hind femur slightly darkened apically.

Specimens examined. West Java: 4, 6, MZB, Bogor, Tanah Sareal, Cimanggu, 23.iv.1996, 250 m asl, Erni, ex larva 4 *E. thrax*; 6, 4, MZB, Bogor, Ciomas, Cimanglid, 19.iii.1996, 500 m asl, Erni, ex larva 4 *E. thrax*; 3, 5, MZB, Bogor, Kedung Halang, Sukaraja, 1.v.1996, 250 m asl, Erniwati, ex larva *E. thrax*; Central Java: 4, 5, MZB, Temanggung, Kedu, 28.iii.2005, 07°16'36.4 S, 110°09'00.4 E, S. Kahono, Erniwati, Sarino, ex larva 4 *E. thrax*.

Distribution. Indonesia: Java (*new record*), Sumatra.

Biology. This species was reared from larva of *E. thrax* (Lepidoptera: Hesperidae).

Superfamily Chalcidoidea

Family Chalcididae

Genus *Brachymeria* Westwood (1829)

Brachymeria lasus Walker (Figure 4b)

Chalcis inclinator Walker (1862: 355), type species *Chalcis inclinator* Walker, synonymized by Joseph, Narendran and Joy (1973: 33); *Chalcis nitator* Walker (1862: 356), type species *Chalcis nitator* Walker; *Chalcis obscurata* Walker (1874: 399), type species *Chalcis obscurata* Walker, synonymized by Joseph, Narendran and Joy (1973: 29); *Oncochalcis marginata* Cameron (1904: 161), type species *Oncochalcis marginata* Cameron, synonymized by Narendran (1985: 88); *Chalcis punctiventris* Cameron (1911), type species *Chalcis punctiventris* Cameron, synonymized by Joseph, Narendran and Joy (1973: 33); *Chalcis papuana* Cameron (1913), type species *Chalcis papuana* Cameron, synonymized by Bou ek (1988:71); *Tumidicoxa regina* Girault (1913: 101), type species *Tumidicoxa regina* Girault, synonymized by Bou ek (1988:71); *Chalcis dentate* Girault 1915: 318), type species *Chalcis dentate* Girault, synonymized by Bou ek (1988:71); *Chalcis copernici* Girault 1936: 2), type species *Chalcis copernici* Girault, synonymized by Bou ek (1988: 71).

Diagnosis. Body length about 6 mm, black; hind coxa black; hind femur black with yellow apically; base of hind

tibia black, remaining yellow; apex of scutellum weakly emarginated; hind coxa of female with a distinct ventromesal tooth; first tergite of gaster smooth and not shagreened.

Specimens examined. *West Java:* 12, MZB, Bogor, Tanah Sareal, Cimanggu, 23.iv.1996, 250 m asl, Erni, ex. pupa *E. thrax*; 1, 2, MZB, Bogor, Ciomas, Cimanglid, 23.iv.1996, 500 m asl, Erni, ex. pupa *E. thrax*; 3, MZB, Gede Pangrango NP, Sukabumi, Bodogol, Resort Office to Research Station, 10.v.2005, 800 m asl, Ubaidillah and Darmawan, sweeping net; 2, MZB, Ciamis, Panjalu, Dukuh, Situ Lengkong, 18.vi.2005, 07°09'S 108°16'E, 800 m asl, Sutrisno and Cholik, sweeping net; 2, MZB, Ciamis, Panjalu, Panambungan, 19.vi.2005, 07°08'S 108°15'E, 800 m asl, Ubaidillah and Darmawan, sweeping net; 2, MZB, Gunung Halimun Salak NP, Sukagalih, Cipeuteuy, rice fields, upland fields, 21.v.2006, 750 m asl, Ubaidillah and Darmawan, sweeping net; 1, MZB, Gede Pangrango NP, Sukabumi, Salabintana track to Camp III, 25.v.2006, 06°50'S 106°57'E, 1,130 m asl, Ubaidillah and Darmawan, sweeping net; *Central Java:* 5, 37, MZB, Grobogan, Tawangharjo, Mayahan, 8.viii.2004, 07°04'27.8 S 110°57'31.9 E, 90 m asl, S. Kahono, Erniwati, Sarino, ex. pupa *E. thrax*; 1, 6, MZB, Temanggung, Kedu, 28.iii.2005, 07°16'36.4 S, 110°09'00.4 E, S. Kahono, Erniwati, Sarino, ex. pupa *E. thrax*; 1, 23, MZB, Purworejo, Bayan, Candisari, 14.viii.2004, 07°43'36.7 S, 109°57'42.8 E, S. Kahono, Erniwati, Sarino, ex. pupa *E. thrax*; 1, MZB, Karimunjawa, P. Parang, 27.iii.2006, Erniwati, sweeping net; 2, MZB, Purwokerto, Baturraden, Botanic Garden trek to Pancuran Tujuh, 28.iii.2006, 109°11'S 07°17'E, 800 m asl, Ubaidillah and Darmawan, sweeping net; 6, MZB, Purwokerto, Baturraden, Botanic Garden trek to Pernalang, 29.iii.2006, 109°15'S 07°17'E, 800 m asl, Ubaidillah and Darmawan, sweeping net; 1, MZB, Cilacap, Nusa Kambangan, Sodong, Kali Nyamuk, 31.iii.2006, 07°45'S 108°56'E, 107 m asl, Ubaidillah and Darmawan, sweeping net; 2, MZB, Cilacap, Nusa Kambangan, Sodong, Limus Buntu, 31.iii.2006, 07°44'S 108°56'E, 98 m asl, Ubaidillah and Darmawan, sweeping net; 1, MZB, Cilacap, Nusa Kambangan, Karang Tengah ke Banteng, 01.iv.2006, 07°43'S 108°34'E, 98 m asl, Ubaidillah and Darmawan, sweeping net; *Yogyakarta:* 1, 8, MZB, Sleman, Pakem, Purwobinangun, Turgo Atas, 25.iii.2005 dan 13.vii.2005, 07°35'S 110°25'E, 1.100 m asl, Ubaidillah, Rofik and Darmawan, sweeping net; 2, 5, MZB, Sleman, Pakem, Purwobinangun, Turgo Bawah, 14-15.vii.2005, 07°35'S 110°24'E, 910 m asl, Ubaidillah, Rofik and Darmawan, sweeping net; *East Java:* 1, MZB, Mojokerto, Kemlagi, 8.viii.2004, 120 m asl, 107°27'25.5 S, 112°20'31.1 E, S. Kahono, Erniwati, Sarino, ex. pupa *E. thrax*; 3, MZB, Jember, Tempurejo, Andongrejo, from Meru Betiri NP to Bande Alit, 02.v.2005, 08°24'S 113°44'E, 264 m asl, Ubaidillah, Cholik, Darmawan, sweeping net; 1, MZB, Jember, Tempurejo, Andongrejo, from Meru Betiri NP to Bande Alit, 03.v.2005, 08°24'S 113°44'E, 264 m asl, Ubaidillah, Cholik, Darmawan, sweeping net.

Distribution. Indonesia: Java, Sumatra, Nusa Tenggara, Sulawesi and Papua; Australasia; Holarctic; Nearctic; North Africa; Oceanic; Oriental; Palearctic.

Biology. This species has been known to be parasitoid on about 120 species of other insects. For more detailed information of its host record see Noyes (2002).

Brachymeria thracis Crawford

Chalcis thracis Crawford (1911: 272), type species *Chalcis thracis* Crawford, synonymized by Narendran (1989: 257); *Brachymeria medicina* Joseph, Narendran and Joy (1970: 289-291), type species *Brachymeria medicina* Joseph, Narendran and Joy, synonymized by Narendran (1989: 257)

Diagnosis. This species is closely related to *B. euploea*, however judging from the antennal character and the color pattern on the hind tibia on both sexes this species is more closely related to *B. femorata*. This species can be distinguished by body length about 5 mm, black; hind coxa black; hind femur black with yellow narrow spot apically; base of hind tibia with small black spot, subbasal and apical yellow; antennae swollen apically; apex of scutellum weakly emarginated; hind coxa of female without ventromesal tooth; first tergite of gaster smooth and not shagreened.

Specimens examined. *West Java:* 2, 7, MZB, Bogor, Ciomas, Cimanglid, 15.xi.1995, 500 m asl, Erni, ex. pupa *E. thrax*; 8, 7, MZB, Bogor, Ciomas, Cimanglid, 23.iv.1996, 500 m asl, Erni, ex. pupa *E. thrax*; 2, 3, MZB, Bogor, Ciomas, Cimanglid, 20.vi.1996, 500 m asl, Erniwati, ex. pupa *E. thrax*; *Central Java:* 9, 3, MZB, Klaten, Kebonarum 07°40'57.4 S, 110°32'27.3 E, 252 m asl, 28.iii.2005, S. Kahono, Erniwati, Sarino, ex. pupa *E. thrax*; 2, 3, MZB, Karimunjawa, P. Parang, 26.iii.2006, 1 m asl, Erniwati, sweeping net; 3, 3, MZB, Karimunjawa, Legon Lele, 4.iv.2006, 1 m asl, Erniwati, sweeping net; 3, 3, MZB, Karimunjawa, P. Nyamuk, 1.iv.2006, 05°44'10 S, 110°31'05 E, 1 m asl, Erniwati, sweeping net; *East Java:* 3, 6, MZB, Mojokerto, Kemlagi, 8.viii.2004, 120 m asl, 107°27'25.5 S, 112°20'31.1 E, S. Kahono, Erniwati, Sarino, ex. pupa *E. thrax*.

Distribution. Indonesia: Java (*new record*), Sumatra; India: Kerala; the Philippines.

Biology. This species was reared from the larvae of *E. thrax* which emerged in the pupal stage.

Family Encyrtidae

Genus *Ooencyrtus* Ashmead (1904)

Ooencyrtus pallidipes Ashmead (Figure 6a)

Aphidencyrtus pallidipes Ashmead (1904: 15), type species *Aphidencyrtus pallidipes* Ashmead, transferred to *Ooencyrtus* by Noyes and Hayat (1984: 309); *Ooencyrtus erionotae* Ferriere (1931: 284), type species *Ooencyrtus erionotae* 1931, synonymized by Huang and Noyes (1994: 51).

Diagnosis. This species can be easily distinguished by the following characters: body size about 1 mm, body colour dark metallic brown, legs yellowish brown; antennae yellowish with scape dark brown; fronto vertex less than 1/5 head width; all segments of flagellomere

longer than wide; sculpture on anterior scutellum punctuate-reticulate with smooth anteriorly; forewing with marginal vein shorter than stigmal vein.

Specimens examined. West Java: 4 ♂, 4 ♀, MZB, Bogor, Ciomas, Cimanglid 26.iii.1996; 2 ♂, MZB, 21. v.1996, 500 m asl, Erniwati, ex. eggs *E. thrax*; 1 ♂, Bogor, Bogor Botanic Garden, 250 m asl, Erniwati, ex. eggs *E. thrax*; East Java: 18 ♂, MZB, Mojokerto, Kemlagi, Bentro, 8.viii.2004, 07°27'25.5 S 112°20'31.1 E, 120 m asl, S. Kahono, Erniwati, Sarino, ex. eggs *E. thrax*.

Distribution. Indonesia: Java; India: Andhra Pradesh, Assam, Karnataka; Malaysia; the Philippines; USA: Hawaii.

Biology. This species was bred from the eggs of *E. thrax* and other hesperiid species such as, *Pelopidas thrax*, as well as papilionid eggs of *Papilio demoleus* and pierid eggs of *Delias hyparete*.

Family Eupelmidae

Genus *Anastatus* Motschulsky (1859)

Anastatus sp. (Figure 6b)

Diagnosis. This is one of few species of *Anastatus* sp. recorded from Java in which the antenna has eight segments of flagellomere plus a single annulus; mesoscutum of female impressed, at least posteriorly; mesopleural area slightly convex; middle tibial spur long and hairy. The body is dark blue metallic, and forewing with a long marginal vein and two large dark infumation. The fore and hind coxae are widely separated. Judging from the diagnostic characters above, we predicted this species belong to undescribed species.

Specimens examined: East Java: 6 ♂, 1 ♀, MZB, South Malang, Sumberejo, Ampel, 19.iv.1995, Erniwati ex, eggs *E. thrax*.

Distribution. This species known only from the specimen localities.

Biology. This species was reared from the eggs of *E. thrax*.

Family Eulopidae

Genus *Pediobius* Walker (1846)

Pediobius erionotae Kerrich (1973 (Figure 7a)

Pediobius erionotae Kerrich (1973: 113), type species *Pediobius erionotae* Kerrich (1973).

Diagnosis. This species is easily distinguished from other members of *Pediobius* sp. by the combination of characters, body shining and brightly colored, head moderately emarginated behind posterior ocelli, median band of scutellum broad, smooth and shining propodeum and nucha very weakly emarginated at apex. Most specimens were reared from eggs of banana leaf roller *E. thrax*.

Specimens examined. West Java: 3 ♂, 1 ♀, MZB, Bogor, Bogor Botanic Garden, 26.iii.1996, 250 m asl, Erniwati, ex. eggs *E. thrax*; 5 ♂, 2 ♀, MZB, Bogor, Kedung Halang, Sukaraja, 21.v.1996, 250 m asl. Erniwati, ex. eggs *E. thrax*; East Java: 7 ♂, 11 ♀, MZB, Mojokerto, Kemlagi, Bentro, 8.viii.2004, 07°27'25.5 S 112°20'31.1 E, 120 m asl, S. Kahono, Erniwati, Sarino, ex. eggs *E. thrax*.

Distribution. Indonesia: Sumatra, Java; Malaysia: Sabah (Purnamasari and Ubaidillah 2007).

Biology. This species was reared from the eggs of *E. thrax*. also as hyperparasitoid of *Cotesia erionotae*.

Genus *Sympiesis* Förster (1856)

Sympiesis sp.

Diagnosis. This species is closely related to the group of *S. javanica*, in some characters also close to the group of *S. dolichogaster*, but in the combination of its characters does not allow its placing in any these groups. These combination characters of this species are: both sexes have four funicular flagellomeres; first to third male flagellomeres branched basally. Posterior margin of clypeus slightly concave; mesoscutal notauli incomplete; setae on mesoscutal midlobe usually arranged in regular longitudinal rows (if not, then propodeum without median carina or plicae); scutellum without sublateral grooves, reticulately sculptured; sculpture on mesoscutum, scutellum, and axillae nearly uniform. Postmarginal vein 2x stigmal vein length or longer; disc sometimes infusate near stigma and/or parastigma; speculum present, basal cell bare; basal and cubital veins setose; 1 long row of admarginal setae present but not entirely exposed by speculum. Body predominantly metallic bluish green; head and mesosoma metallic bluish green; antennal scape pale yellow.

Specimens examined. West Java: 5 ♂, 4 ♀, MZB, Pasuruan, Sugro 10.viii.2004, 07°54'38 S 112°50'38 E, 1,860 m asl, S. Kahono, Erniwati, Sarino, ex. 2nd instar larvae of *E. thrax*.

Distribution. Indonesia: East Java.

Biology. This species was reared from the 2nd instar larvae of *E. thrax*.

Family Pteromalidae

Genus *Agiommatus* Crawford (1911)

Agiommatus sumatraensis Crawford (Figure 7b)

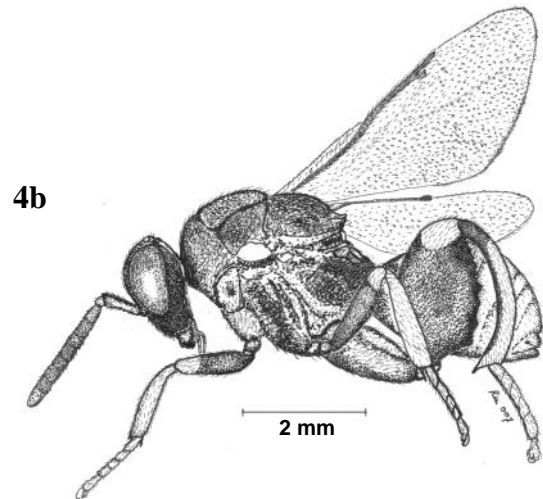
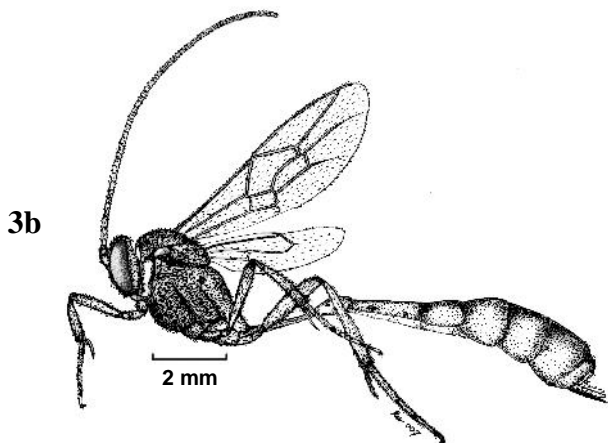
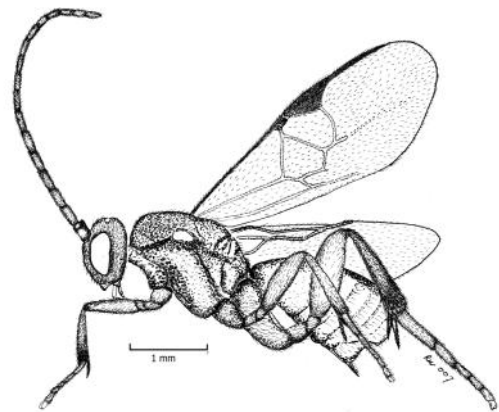
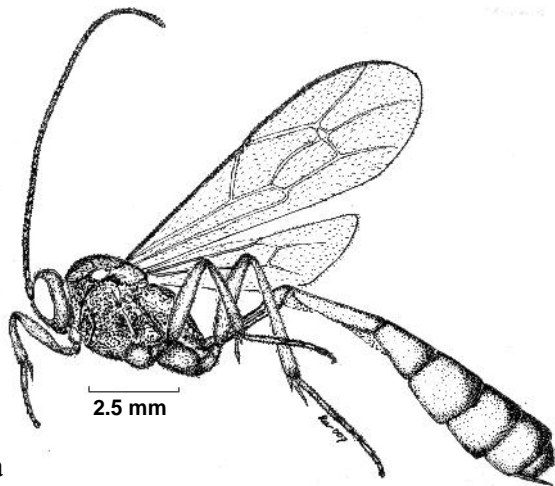
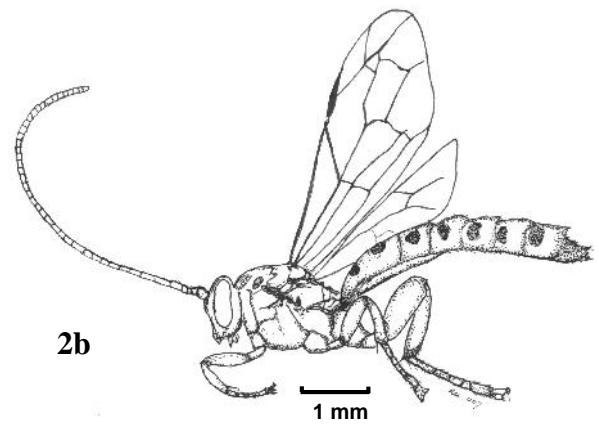
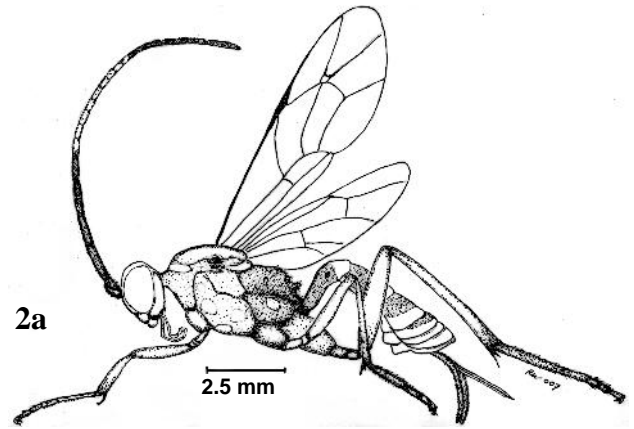
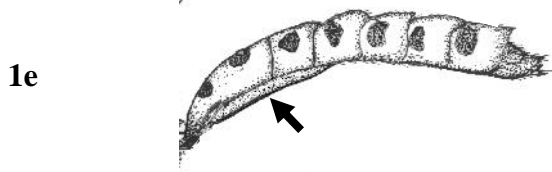
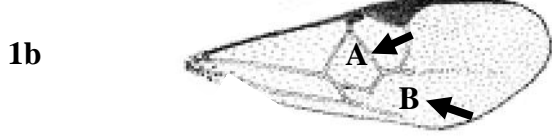
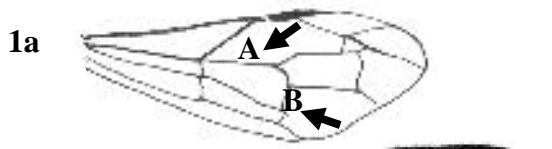
Agiommatus sumatraensis Crawford (1911: 267), type species *Agiommatus sumatraensis* Crawford, original description.

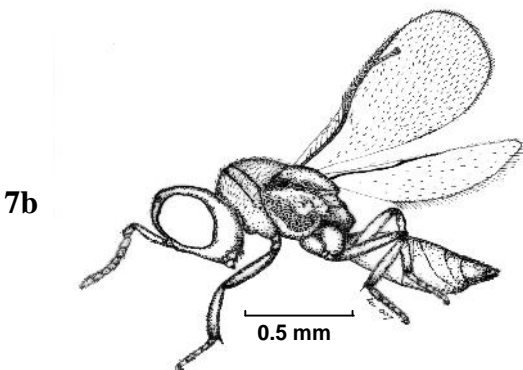
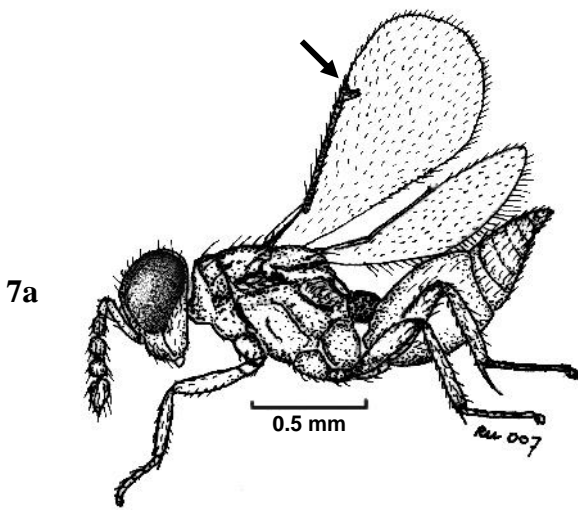
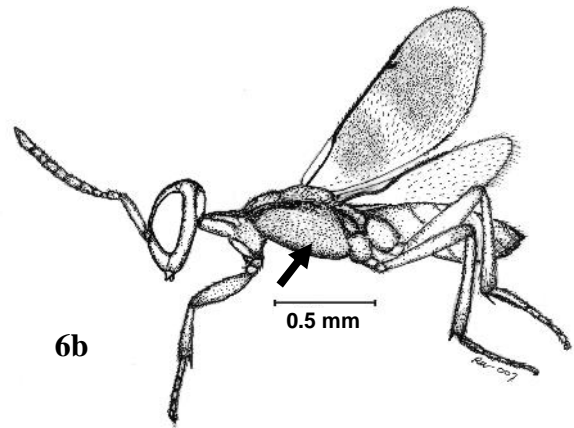
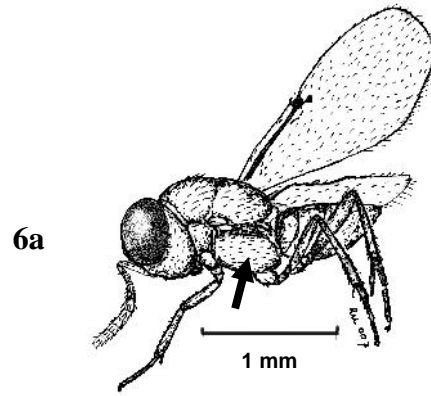
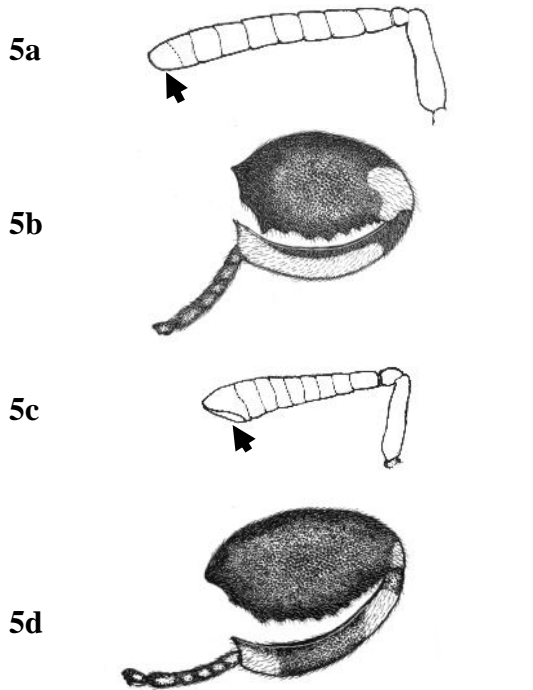
Diagnosis: This species can be easily recognised by the following characters, body length about 1.5 mm; antennae short, pale, with three annelli; clypeal margin produced, with rather deep and broad emarginated; pronotal end rounded; mesoscutum with notauli not complete; scutellum regularly reticulate, without sternal separation; propodeum with an anterior depression which is subdivided by costula.

Specimens examined. West Java: 16 ♂, MZB, Bogor, Tanah Sereal, Cimanggu, 19.iv.1996, 250 m asl, Erni, ex. eggs *E. thrax*; 5 ♂, 5 ♀, MZB, Bogor, Kedung Halang, Sukaraja, 21.v.1996; 15 ♂, 6 ♀, 26.v.1996, 250 m asl. Erniwati, ex. eggs *E. thrax*; East Java: 1 ♂, 16 ♀, MZB, Mojokerto, Kemlagi, Bentro, 8.viii.2004, 07°27'25.5 S 112°20'31.1 E, 120 m asl, S. Kahono, Erniwati, Sarino, ex. eggs *E. thrax*.

Biology. This species was reared from the eggs of *E. thrax*.

Distribution. Indonesia: Java (*new record*), Sumatra.





Figures:

1. a. Forewing of *Xanthopimpla gampsura* Krieger;
 b. Forewing of *Apanteles (Cotesia) erionotae* Wilkinson;
 c. Forewing of *Ooencyrtus erionotae* Ferriere;
 d. Fore wing of *Brachymeria lasus* Walker;
 e. Lateral view, metasoma of *Xanthopimpla gampsura* Krieger
2. a. *Theronia zebra-zebra* Vollenhoven
 b. *Xanthopimpla gampsura* Krieger
3. a. *Casinaria* sp.
 b. *Charops* sp.
4. a. *Cotesia erionotae* Wilk
 b. *Brachymeria lasus* Walker
5. a. Antenna of *Brachymeria lasus* Walker
 b. Hind leg of *Brachymeria lasus* Walker
 c. Antenna of *Brachymeria thracis* Crawford
 d. Hind leg of *Brachymeria thracis* Crawford
6. a. *Ooencyrtus pallidippes* Ashmead
 b. *Anastatus* sp.
7. a. *Pediobius erionotae* Kerrich
 b. *Agiomatus sumatraensis* Crawford

CONCLUSION

Our results demonstrate that hymenopteran parasitoids of banana-skipper *E. thrax* L. differentially occurred throughout the three provinces of Java surveyed. However, this may have been influenced by the size of the eggs, larvae, and pupae collected. The Javanese banana-skipper is parasitized by 12 species of hymenopteran parasitoids. There are four species, namely: *Oo. pallidippes* Ashmead, *Anastatus* sp., *P. erionotae* Kerrich and *A. sumatraensis* Crawford parasitized eggs and four species, namely: *Casinarina* sp., *Charops* sp., *Cotesia (Apanteles) erionotae* Wilkinson, and *Sympiesis* sp. emerged from larvae; and four other species, *T. zebra-zebra* Vollenhoven, *X. gampsura* Krieger, *B. lasus* Walker and *B. thracis* Crawford emerged from pupae of *E. thrax*. Several species such as *Oo. pallidippes* and *Sympiesis* sp. have been known as primary parasitoids and some others such as *P. erionotae* have been noted as hyperparasitoids Noyes (2002). However, further detailed studies needed to clearly understand the tropic of the parasitoids. The presence in Java of an important fauna of parasitoids of the banana-skipper is a serious asset in the perspective of the biological control. It would be necessary to complete this survey by studying the taxonomy of the unknown or undescribed species of hymenopteran parasitoids such as *Casinarina* sp., *Charops* sp., *Anastatus* sp. and *Sympiesis* sp. This related work will also to provide additional data on the biodiversity of these important insects for the integrated pest management program.

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