

A NEW SPECIES OF **ZAGRAMMOSOMA (HYMENOPTERA: EULOPHIDAE)** FROM THE **INDO-AUSTRALIAN** REGION,
A PARASITOID OF THE INVASIVE PEST SPECIES
LIRIOMYZA HUIDOBRENSIS (DIPTERA: AGROMYZIDAE)

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ABSTRACT. *Zagrammosorna latilineaturn* Ubaidillah, sp. nov. is described from Indonesia and Australia (Queensland). It has been reared from *Liriomyza huidobrensis*, an introduced pest of potatoes and other crops in Southeast Asia. This is the first record of *Zagrammosorna* from Southeast Asia. The biology of *Zagrammosorna* species is reviewed.

Introduction

This paper describes a new species of *Zagrammosoma* from Southeast Asia that was reared as a parasitoid of *Liriomyza huidobrensis* (Blanchard) (Diptera: Agromyzidae), a pest species which recently invaded Southeast Asia. This represents a new record for the genus *Zagrammosorna* from South-east Asia, and is the first species of *Zagrammosoma* described from Australasia. The native host of this species is unknown.

The first infestation of *Liriomyza huidobrensis* in Indonesia was detected on a potato crop in Cisarua (West Java) in 1994 (Shepard *et al.*, 1996; 1998). In the following years, the pest invaded other vegetable regions of Java and Sumatra, where it attacks a wide variety of highland vegetables such as potato, beans, snowpeas, celery, cucumber, chillies, tomatoes and spinach (Shepard *et al.*, 1998). Similar observations were made in Malaysia and Viet Nam, where this species has also recently invaded (Sivapragasam *et al.*, 1999; Thang, 1999).

On these crops, yield losses up to 60-70% were common (Rauf & Shepard, 1999), and in some areas a percentage of farmers have actually abandoned vegetable cultivation due to the severity of the leafminer problems (Sivapra-

gasam *et al.*, 1999). Three major pest agromyzid species now occur in South-east Asia, *Liriomyza sativae* in the lowlands, and *L. huidobrensis* and *Chroina toinyia horticola* in the highlands (Rauf & Shepard, 1999; Sivapragasam *et al.*, 1999).

Farmers attempted to control leafminers by applying insecticides two to three times weekly, although these applications were neither effective nor economical (Rauf & Shepard, 1999). Thus, efforts are being initiated to utilize natural enemies to control the leafminers (Rauf & Shepard, 1999; Zamzami, 1999). Field surveys conducted as part of these efforts in Indonesia yielded 10 species of hymenopteran parasitoids, and one of them is the *Zagrammosoma* species being described in this paper.

Although generally one of the most distinctive and beautiful of the eulophid genera, the exact limits and definition of *Zagrammosorna* are not clear. It is quite close to the genus *Cirrospilus*, and differences between *Zagrammosorna* and *Cirrospilus* have been discussed by Bouček (1988), LaSalle (1989), and Hansson & LaSalle (1996). The main differences between the genera are that in *Zagrammosoma* the vertex is vaulted and extends much higher than the compound eye, and the notaulus is curved and extends to the anterior margin of the advanced axilla; in *Cirrospilus* the vertex is not vaulted and does not extend higher than the compound eye, and the notaulus is relatively straight and extends to the scuto-scutellar suture (although see Hansson & LaSalle, 1996, for an exception to these characters). Additionally, *Zagrammosoma* species are generally yellow and black or more rarely black in coloration (never metallic), and often have dark markings on the fore wing.

A problem taxon for the definition of these two genera is *Cirrospilus variegatus* (Masi, 1907). Originally described in the genus *Atoposoma*, this species has been variously placed in the valid genus *Zagrammosoma* (Gordh, 1978, Kurashev, 1991, Yefremova, 1995a), in the subgenus *Zagrammosoma* within *Cirrospilus* (Bouček, 1959; Bouček & Askew, 1968) or in the genus *Cirrospilus* which is considered to be distinct from *Zagrammosoma* (Bouček, 1988). In *C. variegatus* the vertex is slightly to distinctly vaulted and extends higher than the compound eye, however the notaulus is complete to the scuto-scutellar suture.

Studies on the validity of *Zagrammosorna* and the exact relationships of *Zagrammosorna*, *Cirrospilus* and the species related to *C. variegatus* are currently underway. For the purposes of this paper, we are taking the definition of *Zagrammosorna* as used by Bouček (1988), LaSalle (1989), and Hansson & LaSalle (1996), which would exclude *C. variegatus* because it has the notaulus extending to the scuto-scutellar suture. Table 1 lists species currently belonging to *Zagrammosoma*.

Abbreviations: Morphological terminology follows Bouček (1988). Acronyms used in the text are as follows. Collections: ANIC, Australian National Insect Collection, CSIRO, Canberra, Australia; BMNH, The Natural History Museum, London, UK; MZB, Museum Zoologicum Bogoriense, Bogor, Indonesia. Terminology: MV, marginal vein; OOL, oculo-ocellar length, the distance

between the lateral ocellus and eye margin; POL, postero-ocellar length, the distance between the lateral ocelli; PMV, postmarginal vein; SMV, submarginal vein; and SV, stigmal vein.

Zagrammosoma latilineatum Ubaidillah, **sp. nov.** (Figs. 1-4)

Diagnosis: Median dark stripe on the mesoscutum and scutellum broad, at the scuto-scutellar suture distinctly broader than the yellow parts lateral to it; propodeum almost entirely dark; occiput with two wide longitudinal stripes, connected by transverse stripes on vertex and at gena. Fore wing hyaline with dark markings restricted to a small area around stigmal vein and parastigma; postmarginal vein short, less than 0.25 the length of stigmal vein; speculum separated from bare area posterior to marginal vein by a transverse row of 2-4 setae; 4-5 admarginal setae present.

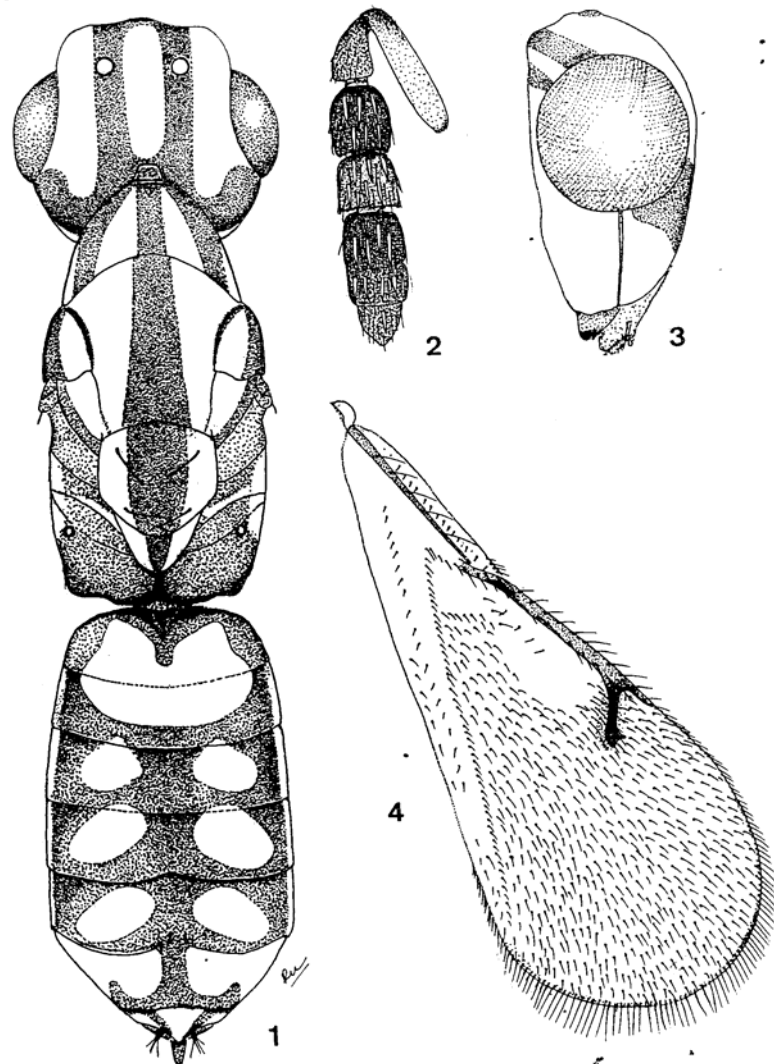
Female (Fig. 1): Length 1.1-1.6 mm. Frons pale yellow with two transverse brown stripes under vertex connecting to eye, lower one narrower than upper one; vertex and occiput with two wide longitudinal stripes, connected by transverse stripes on vertex and at gena (Figs. 1, 3). Scape pale yellow, brown apically; pedicel and flagellum dark except paler on second funicular and third segment of club. Mesosoma predominantly pale yellow with broad medial stripe (Fig. 1), darker along notauli, and two stripes along lateral mesosoma toward propodeum, propodeum entirely dark. Legs predominantly yellow pale except brownish on last segment of basitarsus and a transverse stripe near the apex of the hind femur. Fore wing hyaline with dark marking around stigmal vein and apex of parastigma. Metasoma with sternites and lateral tergites pale yellow, tergites dorsally with dark markings as in Fig. 1.

Head (Figs. 1, 3): Frons and vertex shiny, with fine-meshed reticulation. Vertex vaulted between the compound eyes, the head elongate. Malar sulcus straight, malar space 0.6-0.65 times eye height. OOL/POL 0.6-0.9. Maxillary and labial palps one segmented, mandible with two big apical teeth and three small teeth.

Antenna (Fig. 2) with two anelli, two funicular segments, and a three-segmented club, the first funicular segment slightly longer than the transverse second segment, sensillae present on all funicular and club segments.

Mesosoma dorsally with fine dense reticulation. Mesoscutum with notaulus distinct and complete to apex of axilla at a distance well separated from scuto-scutellar suture. Midlobe of mesoscutum with three pairs of setae. Axilla advanced, the -major part placed anterior to scuto-scutellar suture. Scutellum slightly wider than long with two to three pairs of setae. Propodeum with fine sculpture, shiny and the median carinae indicated only for a short distance posteriorly,

Fore wing (Fig. 4): SMV tapering at apex and joining parastigma above distal end; with 5 setae on dorsal margin. Costal cell with about four dorsal setae on anterior margin apically, and an almost complete line of ventral setae. MV approximately as long as SMV; PMV very short, less than 0.25 length of SV. Admarginal area bare on dorsal surface of wing, with 4-5 setae



Figures 1-4. *Zagrammosoma latilineatum*, female: 1, habitus; 2, Antenna; 3, head, lateral view; 4, fore wing.

Metasoma with petiole short and transverse. Gaster about equal in length to mesosoma. Tergites 1 to 6 subequal uniform in size; sculpture finely reticulate dorsally and laterally.

Male: Unknown.

Host: *Liriomyza huidobrensis* (Blanchard) on potato. *L. huidobrensis* is an introduced pest; the indigenous host of this species remains unknown.

Distribution: Indonesia, Australia.

Holotype: ♀, INDONESIA: West Java: Bandung, Parigalengan, ex. *Liriomyza huidobrensis* on potato, collected 11.xi.1997, emerged 20-28.xi.97. Coll. A. Rauf (MZB).

Paratypes: 19 ♀, same label data as holotype (BMNH). AUSTRALIA: Queensland: Emerald, at Nogo Riv., 19 ♀, 13.iv.1988. J. D. Pinto & G. D. Gordh (ANIC)

Etymology: The species name is taken from the Latin *latus* (wide) and *lineatus* (line), and refers to the broad, dark longitudinal stripe on the mesosoma.

Discussion: Bouček (1988) mentioned undescribed species of *Zagrammosoma* from Asia and Australia, however *Zagrammosoma latilineatum* is the first species actually described from this region. Liao (in Liao *et al.*, 1987) described *Zagrammosoma lutelineatus* from China, but this species does not properly belong in *Zagrammosoma* (Zhu, in prep).

Despite recent works on *Zagrammosoma* (Gordh, 1978; LaSalle, 1989; Yefremova, 1995 a, b) species definitions still need work as most descriptions and keys are based mainly on color, and this can vary in some species. For example, there is color variation in *Z. americanum* (Gordh, 1978), and problems of assessing color variation have been discussed for *Z. mirum* and *Z. flauolineatum* (Gordh, 1978; LaSalle, 1989). Future work is necessary to document levels of color variation within species, and to find morphological characters to support species.

Biology of *Zagrammosoma*

Host associations of *Zagrammosoma* species are given in Table 1. Where the biology is known, species are ectoparasitoids of the larvae of leafmining insects (Lepidoptera, Coleoptera, Hymenoptera, Diptera) (Noyes, 1998). Individual species can have a wide host-range_ often attacking insects in several different orders. When species of *Zagrammosoma* are only known from a single host, that host is usually lepidopterous. However, host associations in *Zagrammosoma* appear to be based on niche specialization (i.e. leafminers) rather than a taxonomic specialization. So, although one might assume from the data presented in Table 1 that the baseline biology for *Zagrammosoma* is as a parasitoid on lepidopterous leafminers, any radiation from that biology in generalist species is onto leafminers in other orders rather than Lepidoptera in different ecological niches.

Table 1. World Species of *Zagrammosoma* with host associations (taken from Noyes, 1998; but including a synonymy by Evans, 1999). All species are primary ectoparasitoids of larvae of leafmining insects

<i>Zagrammosoma</i> species	Host: Order, Family, species
<i>americanum</i> Girault 1916b New World	COLEOPTERA: Buprestidae : <i>Brachys tessellatus</i> sp. DIPTERA: Agromyzidae : <i>Liriomyza</i> sp. LEPIDOPTERA: Bucculatricidae : <i>Bucculatrix thurberiella</i> . Gelechiidae : <i>Coleotechnites</i> sp., <i>C. mil/eh.</i> Gracillariidae : <i>Phyllocnistis citrella</i> .
<i>buselus</i> (Walker 1839) New World	Unknown
<i>centrolineatum</i> Crawford 1913 New World	HYMENOPTERA: Argidae : <i>Scobina</i> sp. LEPIDOPTERA: Gracillariidae : <i>Cameraria mediodorsella</i> , <i>Gracillaria alnivorella</i> , <i>Phyllonorycter</i> sp Tischeriidae : <i>Tischeria</i> sp.
<i>crowei</i> (Kerrich 1969) Old World	LEPIDOPTERA: Lyonetiidae : <i>Leucoptera meyricki</i> . Gracillariidae : <i>Phyllocnistis citrella</i> .
<i>flavolineatum</i> Crawford 1913 New World	LEPIDOPTERA: Gelechiidae : <i>Gnorimoschema operculella</i> .
<i>hobbesi</i> LaSalle 1989 New World	Unknown
<i>intermedium</i> Gordh 1978 New World	LEPIDOPTERA: Gracillariidae : <i>Cameraria nemoris</i> .
<i>latilineatum</i> Ubaidillah sp.n. Old World	DIPTERA: Agromyzidae : <i>Liriomyza huidobrensis</i> .
<i>lineiceps</i> (Girault 1915) New World	DIPTERA: Agromyzidae : <i>Liriomyza</i> sp., <i>L. archboldi</i> . LEPIDOPTERA: Gelechiidae : <i>Keiferia lycopersicella</i> . Lyonetiidae : <i>Perileucoptera coffeella</i> .
<i>melinum</i> Gordh 1978 New World	LEPIDOPTERA: Bucculatricidae : <i>Bucculatrix</i> sp.
<i>mirum</i> Girault 1916a New Wgrld	DIPTERA: Agromyzidae : <i>Liriomyza pictella</i> . LEPIDOPTERA: Gelechiidae : <i>Gnorimoschema operculella</i> , <i>Keiferia lycopersicella</i> . Gracillariidae : <i>Phyllonorycter crataegella</i> , <i>P. elmaella</i> .
<i>multilineatum</i> (Ashmead 1888) New World Synonyms: <i>Z. punicea</i> Girault, 1911 <i>Z. interlineata</i> Girault, 1916b <i>Z. zebalineatum</i> De Santis, 1985	COLEOPTERA: Chrysomelidae : <i>Microrhopala xerene</i> . DIPTERA: Agromyzidae : <i>Agromyza parvicornis</i> , <i>A. pusilla</i> , <i>A.</i> <i>scutellata</i> , <i>Phytomyza aquilegiae</i> , <i>P. minuscula</i> , <i>P vomitoriae</i> HYMENOPTERA-Tenthredinidae: <i>Scolioneura betuleti</i> LEPIDOPTERA: Gracillariidae : <i>Cameraria cincinnatiella</i> , <i>C.</i> <i>hamadryadella</i> , <i>Chrysaster stensackenella</i> , <i>Parornix geminatella</i> , <i>Phyllocnistis citrella</i> , <i>P. magnoliella</i> , <i>Phyllonorycter crataegella</i> . Gelechiidae : <i>Exoteleia pinifoliella</i> , <i>Coleotechnites</i> sp. Lyonetiidae : <i>Perileucoptera coffee/la</i> . Tischeriidae : <i>Tischeria malifoliella</i> .
<i>seini</i> Wolcott 1936 New World	LEPIDOPTERA: Lyonetiidae : <i>Perileucoptera coffee/la</i>
<i>talitzkii</i> (Bou:ek, 1961) . Old World	DIPTERA: Agromyzidae : <i>Liriomyza pseudopygmina</i> . LEPIDOPTERA: Bucculatricidae : <i>Bucculatrix crataegi</i> . Gracillariidae : <i>Betaornix persicella</i> , <i>Lithocolletis salciphaga</i> , <i>P</i> <i>cerasicolella</i> , <i>P. connexella</i> , <i>P. corylifoliella</i> , <i>P malella</i> , <i>P sorbi</i> . Heliozelidae : <i>Holocacista rivillei</i> . Lyonetiidae : <i>Leucoptera malifoliella</i> .
<i>velerii</i> Yefremova, 1995 New World	Unknown

In addition to *Z. latilineatum*, there are five species of *Zagrammosoma* that have been recorded as parasitoids of Agromyzidae, (*americanum*, *lineaticeps*, *mirum*, *multilineatum* and *talitzkii*) (from Noyes, 1998) and all of these species are also recorded from hosts in other orders. So, it seems unlikely that any species of *Zagrammosoma* are specialists on dipterous leafminers, and it is probable that the native host of *Z. latilineatum* is not an agromyzid.

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