

**DESCRIPTION OF *ARMIGERES (ARMIGERES) ALKATIRII*,
A NEW SPECIES FROM SULAWESI, INDONESIA
(DIPTERA: CULICIDAE)**

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ABSTRACT. The male, female, pupa, and fourth-instar larva of *Armigeres (Armigeres) alkatirii* n. sp. from Sulawesi, Indonesia, are described and illustrated. The new species is compared to the closely related *Armigeres (Armigeres) moultoni* Edwards from Sarawak, Malaysia.

INTRODUCTION

This study is based on material collected by the authors in 1991 and 1992 while conducting a cooperative research project with Indonesia entitled "Medical zoological studies on biogeography and coevolution of vectors, parasites and hosts in Indonesia." From this material an interesting new species of the genus *Armigeres* was found. After comparison with descriptions of species of the subgenus *Armigeres* described from Malaysia, Indonesia, Papua New Guinea, and the Philippines, we determined that the new species is closely related to *Armigeres moultoni* Edwards (Edwards, 1914). Terminology used in the description follows Harbach and Knight (1980, 1982).

TAXONOMIC TREATMENT

Armigeres (Armigeres) alkatirii Toma,
Miyagi, and Syafruddin, new species

Male. Wing 3.1 mm. Proboscis 2.4 mm. Forefemur 2.4 mm. Abdomen 3.9 mm. **Head:** Pale scales dingy brown on vertex, dark scales with bluish luster at certain angles. Narrow band of white scales along ocular line, broadening ventrally in postgenal area.

Ocular and frontal setae present. Erect scales absent. Clypeal integument dark. Proboscis long, slightly curved, compressed in apical 0.5, uniformly covered by dark scales. Antenna 1.9 mm. Pedicel and flagellomere 1 with white scales on inner and lower sides. **Thorax:** Integument brown to dark brown. Scutum densely covered with narrow, curved dark brown scales with metallic luster. Paratergite with white scales. Acrostichal, dorso-central, and scutal fossal setae absent. Several strong antealar and supraalar setae present. Prescutellar setae absent. Scutellum covered with flat dark brown scales, with bluish luster at certain angles; several lateral and median scutellar setae present. Mesopostnotum bare, integument brown. Anteprenotal lobe normal in size, with flat white scales and 10-13 setae on front and sides; top and posterior margin mostly with brown scales. Proepisternum covered with large patch of white scales, with 4-6 setae. Upper half of postpronotum covered with narrow brown scales, lower half with broad white scales, 4 setae along posterior border. Subspiracular area with white scales. Prespiracular seta absent. Postspiracular area with patch of white scales, 3, 4 setae. Mesokatepisternum with 2 large patches of white scales, 5, 6 lower and upper mesokatepisternal setae on posterior border; patch of several setae on prealar region. Mesanepimeron with large patch of white scales and 1 seta. Upper mesanepimeron with dense patch of setae. Mesomeron and metameron bare. **Legs:** Forecoxa covered with white scales, with dark scales in center;

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mid- and hindcoxae with white scales on anterior side and posterior border. Coxal setae strong. Fore- and midfemora with white scales on ventral posterior surface extending to apex; hindfemur extensively white-scaled, anterior white scales reaching nearly to apex and posterior white scales extending from middle to apical 0.3. All tibiae subequal in length. *Ungues* (Fig. 11–K): Foreungues much larger than mid- and hindungues, unequal in size, larger one about twice size of smaller one, larger one with submedian tooth. *Midungues* subequal with submedian tooth. *Hindungues* small and simple. *Wing*: Dark-scaled. Cell R_2 about 1.3 of R_{1+2} . Alula with row of small scales. Calypter with row of long hairlike scales. Capitellum dark with brown scales, pedicel and scabellum light in color. *Abdomen* (Fig. 1B,C): Terga I–VII dark-scaled with small patches of white scales laterally; tergum VIII entirely dark-scaled. Sternum I entirely white; sternum II entirely black; sterna III, IV black-scaled with very narrow basal white band; sterna V, VI black-scaled with conspicuous basal white band; sternum VII mostly black-scaled; sternum VIII black-scaled with indistinct pale scales. *Genitalia* (Fig. 1A,F): Tergum IX with apical margin slightly sclerotized, and with shallow depression in center, 4 fine setae on each lobe. Gonocoxite pointed, about 2.5 times as long as its breadth at center, apex with long hornlike bristle as long as gonostylus; dorsal surface of gonocoxite with numerous long brushlike setae on apical half; many long setae arising mesally on apical half of gonocoxite. Basal mesal lobe with 5 stout and many fine setae. Gonostylus inserted distinctly before the tip, about 0.44 length of gonocoxite, reaching stout setae on basal mesal lobe, outer margin convex and inner margin slightly concave, bearing fine

setae toward apical 0.5, row of 5 spiniforms, each spiniform with pointed apex; apical spiniform longer than rest.

Female. Wing 3.5 mm. Proboscis 2.3 mm. Maxillary palpus 0.7 mm. Forefemur 2.6 mm. Resembles male except in the following characters. Palpus 0.3 length of proboscis. Pedicel integument dark with small white scales on inner and lower sides. Antenna 2.1 mm. *Ungues* (Fig. 1F–H): Foreungues large, equal, each with a tooth; midungues smaller, equal, each with a tooth; hindungues same size as midungues, without teeth. *Abdomen* (Fig. 1D): Terga I–VII dark-scaled with patches of white scales on side; tergum VIII mostly white-scaled dorsally. Sternum I white-scaled; sterna II, III dark-scaled with narrow basal white band; sterna V, VI dark-scaled with broad white band on basal 0.3–0.5; sterna VII, VIII black-scaled.

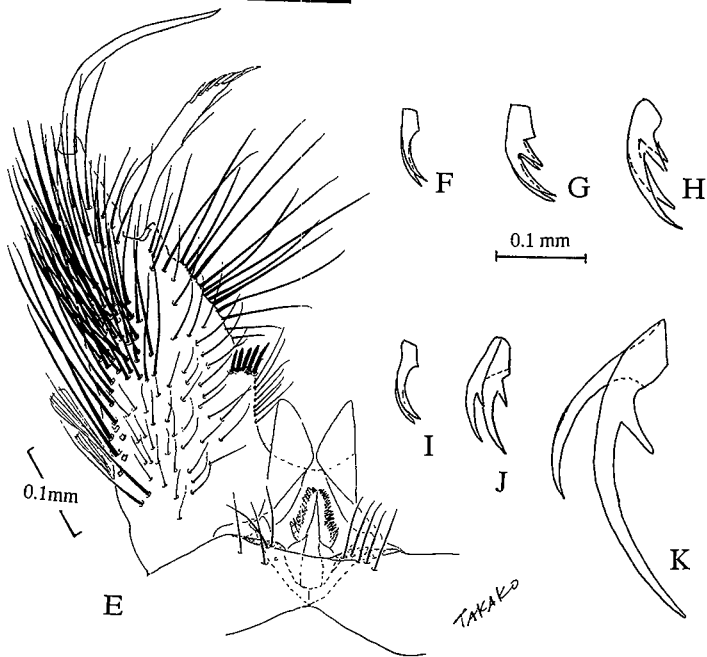
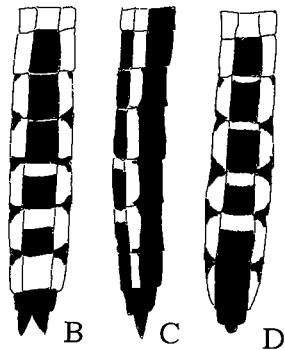
Pupa (Fig. 2). Abdomen 3.7–4.0 mm. Trumpet 0.44–0.51 mm. Paddle 0.86–0.89 mm. Integument yellow to light brown. Chaetotaxy as in Table 1. *Trumpet*: Brown, index 2.1–2.4. *Abdomen*: All segments with very fine spicules. Male genital lobe extending to 0.54 of paddle, female genital lobe extending to 0.26 of paddle. *Paddle*: Lightly pigmented, with fine spicules and long fringe, midrib present.

Larva (Fig. 3). Head width 0.81–0.93 mm. Siphon length 0.64–0.71 mm. Saddle length 0.27–0.40 mm. Chaetotaxy as in Table 2. Setae yellow to light brown, none stellate. *Head*: Width 1.2–1.3 length. Light yellowish-brown in color, except slightly darker around mouth and collar. *Antenna*: Length 0.23–0.28 mm; shaft slightly broader from base to apex. Integument smooth, yellow. Seta 1–A inserted 0.42–0.52 from base. *Thorax*: Long and prominent pleural seta with barbs. Setae 9–12–PM, 1 arise from common

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Fig. 1. Adult of *Armigeres (Armigeres) alkatrii*. A, F. Male genitalia; B, C. abdomen of male, B, ventral aspect, C, lateral aspect; D, abdomen of female, ventral aspect; F–H, unguis of female; F, hindungues, G, midungues, H, foreungues; I–K, unguis of male. I, hindungues, J, midungues, K, foreungues.

Fig. 2. Pupa of *Armigeres (Armigeres) alkatrii*. A, Cephalothorax of male, B, terminal part of abdomen of female; C, metanotum and abdomen of male.



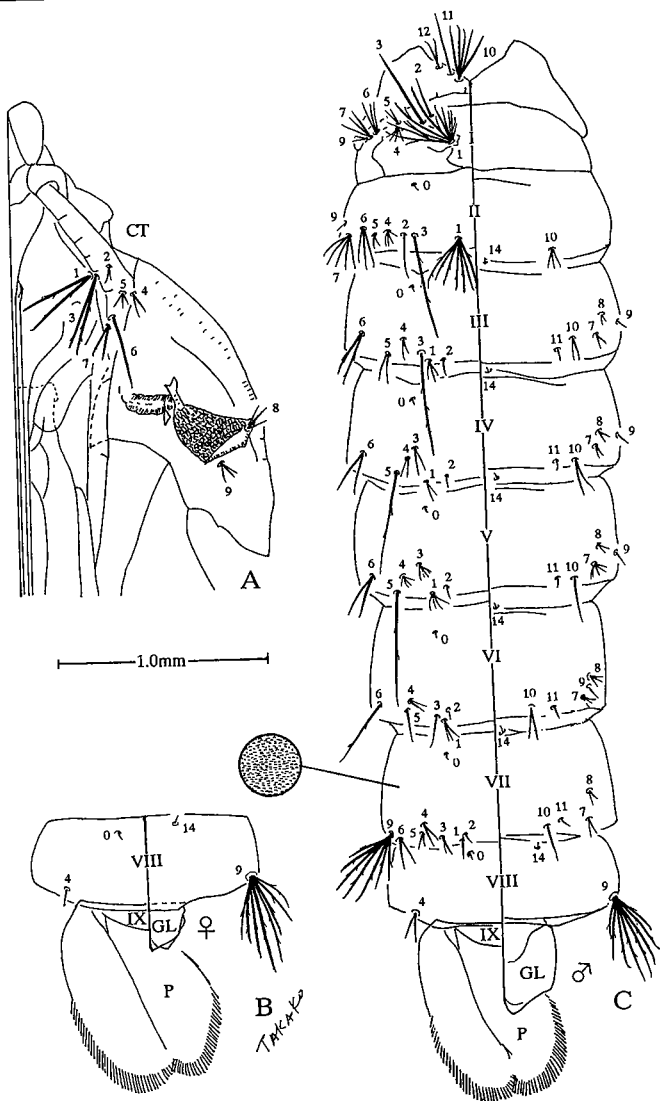


Table 1. Chaetotaxy of the pupa of *Armigeres (Armigeres) alkatirii*.

Seta no.	Cephalo-thorax	Abdominal segments							
		I	II	III	IV	V	VI	VII	VIII
0	—	—	1	1	1	1	1	1	1
1	2-5 ^{r1}	M ²	7-11	2-5	3-6	2-5	2,3	1,2	—
2	2,3	1	1	1	1	1	1	1	—
3	2,3*	1 ²	1*	1 ²	4,5	2,3	1,2	2,3	—
4	2-5	4-6	4,5	2,3	2,3	4,5	1-3	1-3	1-4
5	3,4	2,3	2	2-4	1,3 ²	1-3*	1	1,2	—
6	1*	3,4	4	1,2*	2	1,2	1,2 ³	2,3	—
7	2,3	2-4	5	2-4	2-4	3-6	2-4	2,3	—
8	2-4	—	—	2-4	2,3	2,3	2-5	2-4	—
9	3,4	2	1	1	1	1	7,8 ⁴	8-10*	—
10	5-7	—	3-5	2-4	1,2	1,2	1-3	1-3	—
11	1*	—	—	1	1	1	1	1,2	—
12	1-3	—	—	—	—	—	—	—	—
14	—	—	—	1	1	1	1	1	1

1* = Prominent seta.

2 M = multiple branched.

tubercle. *Abdomen*: Comb with 3-5 fringed scales. *Siphon*: Short, brown; index 1.2-1.7; seta 1-S single, conspicuous, arising 0.93-0.98 from base. *Segment X*: Saddle incomplete, brown. Anal papillae long, with bluntly pointed apices. Seta 1-X 3-8 b, 2-X 4-8 b, 3-X 3-7 b, 4a-X 4-7 b, 4b-X 5-9 b, 4c-X 6-10 b, 4d-X 7-12 b, 4e-X 8-14 b.

Type Material. Holotype male (900815-3, no. 57, G-5) with associated larval and pupal exuviae mounted on a slide, one female paratype with slide (900815-3, no. 59, pl), and 2 male paratypes (900815-3 and 900815-3, G-4) from Matayagan, North Sulawesi, Indonesia, 15 August 1991, collected as larva from a coconut shell by I. Miyagi. Holotype and additional specimens will be deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC, U.S.A.

Etymology. We are pleased to name this species in honor of Junus Alkatiri, Dean, University of Hasanuddin, Ujung Pandang, Indonesia, for his contributions to medical education and for his support and encouragement during our field research in Sulawesi.

Taxonomic discussion. *Armigeres (Arm.) alkatirii* is extremely similar to *Ar. (Arm.) moultoni*. However, the adult sterna and male genital structures are quite different. Sternum II is entirely black, the apical white band of sterna IV-VI is narrow when compared with the basal black band, and the gonocoxite is pointed and with a long hornlike apical bristle that is as long as the gonostylus. A male specimen from Sarawak identified by S. Ramalingam as *Ar. moultoni* and descriptions in Borel (1930) and Bonne-Wepster and Brug (1937) indicate that sternum II is entirely white and the apical white bands of sterna IV-VI are broad when compared with the basal black bands. The apical hornlike bristle of the gonocoxite is absent.

Bionomics. Immatures of *Ar. alkatirii* were found in a coconut shell at ground level associated with *Armigeres malayi* (Theobald) and in a stem hole of a sago tree with *Armigeres joloensis* (Ludlow). Medical importance not known.

Distribution. Known only from Sulawesi, Indonesia.

Specimens examined. 8 males, 2 females,

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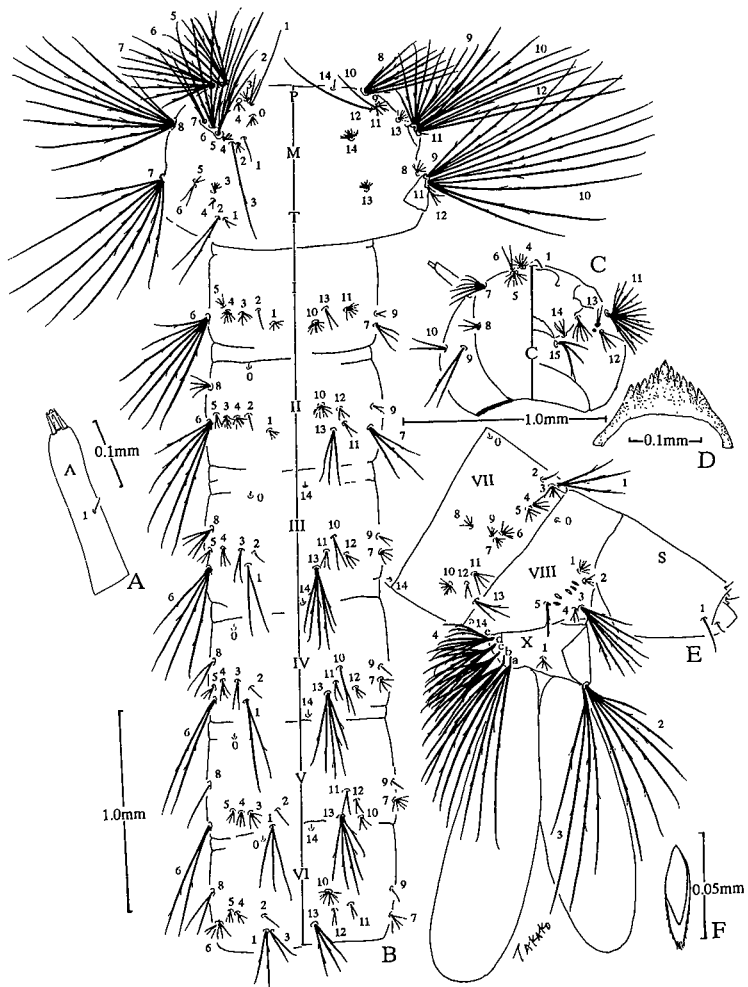


Table 2. Chaetotaxy of the fourth-instar larva of *Armigeres (Armigeres) alkatirii*.

Seta no.	Thorax			Abdominal segments												
	Head	P	M	T	I	II	III	IV	V	VI	VII	VIII				
0	—	5-8	—	—	—	1-3(1,2) ¹	1	—	1	2-6*	1	1-4 ^s	1	2-5*	1	5-12
1	1	1-3(1,2)	1	2-4	5-13	1-3(2)*	1	1-3*	1	2-6*	1	1	1	1	1	2-6
2	—	2-4	2-5	1-3(2)*	1	1	1	1	1	1	1	1	1	1	1	5-10*
3	—	1-3(1,2)	1-2(1) ^s	3-10	3-9	1-3(2)	1	1-3(2)	1	1-3(2)	1	1	1	1	1	2-6
4	8-11	3-7	4-8	2,3	7-12	5-12	2-7	2-7	1-4	2-6	1-4	2-5	3-6	2-5	2-5	1*
5	5-8	3-5(5) ^s	5-9 ^s	1-3(1,2)	3-5	2-6	2-7	2-6	2-6	3-5	2-5	2-5	2-5	2-6	2-6	1*
6	2	2 ^s	5-9 ^s	1-3(2,3)	5-10*	5-9*	2-6*	2,3*	2*	2*	2*	2*	2*	2*	2*	1*
7	5-8	8-11 ^s	2 ^s	7-14*	2-5	2-5*	4-8	3-6	4-7	3-6	4-7	3-6	3-6	3-6	3-6	1-X
8	2-4	7-13*	8-14*	6-10	—	4-7	2-4	2,3	1-3	2,3(2)	1-3	2,3(2)	4-10	4-10	4-10	2-X
9	2-4(2)*	3-7	9-18*	5-9 ^s	2-5	2-5	1-3	1,2	1,2	1,2	1,2	1,2	3-7	3-7	3-7	3-X
10	2-4(2)	1	4,5*	6-12*	3-9	7-18	2,3(2)	2	1-3	6-12	1-3	6-12	7-14	7-14	7-14	4b-X
11	13-22*	2-4	1	1	7-10	2-5	2-5	1-3	1,2(2)	2-5	1-3	1,2(2)	3-6	3-6	3-6	4c-X
12	3-6	1	4-6*	1-5	—	3-7	2-5	2-4	1-3	2-4	1-3	2-4	2-4	2-4	2-4	4d-X
13	2,3	—	6-9	6-14	1,2	2,3	6-10*	5-9*	4-8 ^s	2-4*	2-4*	2-4*	2-4*	2-4*	2-4*	4e-X
14	3-5	1	6-13	—	—	—	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1-a
15	2-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,2

1. s = prominent seta.

10 larvae and 2 pupae collected from coconuts in northern Sulawesi on 15 Aug. 1991, and from a stem hole of a sago tree at Mamasa, Southern Sulawesi, on 20 July 1992 by T. Toma and I. Miyagi.

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LARVAL GROWTH OF *AEDES POLYNESIENSIS* AND *AEDES AEGYPTI* (DIPTERA: CULICIDAE)

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ABSTRACT. Head capsule widths of *Aedes aegypti* (Linnaeus) and *Aedes polynesiensis* Marks were measured on larvae reared individually in the laboratory. Instars could be identified unambiguously by means of their head capsule widths or by simple examination of peaks in the frequency distribution of widths. *Aedes aegypti* exhibits no sexual difference in development sizes, whereas in *Ae. polynesiensis* third- and fourth-instar widths were significantly smaller in males than in females. Larval growth can be modeled by linear regression of head widths on instar, for both species. The growth rate of *Ae. polynesiensis* females is greater than that of males. Although *Ae. aegypti* always has greater head capsule widths than *Ae. polynesiensis* males, their growth rates are identical. We suggest the use of a method for statistically analyzing mixtures of Gaussian populations. The method is tested on the *Ae. polynesiensis* instar 3 and 4 data set, the aim being to identify the subpopulations of males and females. For instar 4, it gave results identical to the simple measurements previously done, but failed when the subpopulations widely overlap, as in instar 3.

INTRODUCTION

Obtaining knowledge of age structure is an important step in constructing realistic population models for animals. Moreover, basic statistics of population dynamics such as mortality and growth rates can often be inferred from age distribution. In insects that develop through several instars, head capsule width is one of the most often chosen morphometric parameters to identify larval stage and derive basic population parameters such as growth dynamics. This criterion was first recognized by Dyar (1890) who formulated the law of geometric progression of instar growth rate in insects (earlier proposed by Brooks (1886) for the Stomatopoda). Dyar's rule is the analogue of an exponential regression of instar sizes on instar ranks. Many workers have used this technique on different insect orders to classify instars (Miles 1931, Kettle and Lawson 1952, Ghent 1956, Chaker 1983, among others). It has also been successfully used for the larvae of various mos-

quito species to describe their growth (Sen and Das Gupta 1958, Danks and Corbett 1973, De Oliveira and Durand 1978, Deslongchamps and Tourneur 1980). Although the number of instars is well defined for mosquitoes, it is not always easy to determine it for other orders and when Dyar's rule is not applicable *de facto*, various refinements have been introduced to analyze head capsule width data, such as visual inspection of the sample frequency distribution (Curtis and Barnes 1977), regression analysis (Frampton 1986), and statistical analysis of histograms (Kishi 1971, Got 1988, Beaver and Sanderson 1989). Modal analysis of head capsule width histograms can help in differentiating between instars, even if overlapping occurs. In that case, the boundary between two successive instars can be difficult to determine and statistical procedures have to be employed (Beaver and Sanderson 1989). Moreover, subpopulations (e.g., as defined by sex) can increase variability within instars and make the number of instars impossible to determine. Discriminating between successive instars by frequency analysis techniques can be difficult or impossible if groups overlap widely (Schmidt et al. 1977).

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