

## Re-description of *Dahlia geniculata* and *Dahlia echinus* pupae (Diptera: Culicidae) and morphological key for identification of phytotelmic aedine pupae in the Palearctic Region

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### Abstract

The pupae of *Dahlia geniculata* (Olivier) and *Da. echinus* (Edwards) are described and illustrated completely for the first time. A table lists the range and the mode of the branching of each pupal seta. A short key is given for identification of phytotelmic aedine pupae, i.e. *Da. geniculata*, *Da. echinus* and *Da. gilcolladoi* (Villa, Rodríguez & Llera), *Ochlerotatus berlandi* (Seguy) and *Oc. pulcritarsis* (Rondani).

Keys Words: *Dahlia geniculata*, *Dahlia echinus*, pupa, Spain.

### Introduction

In the Palearctic Region, the immature stages of seven mosquito species develop in tree holes. Traditionally the pupal stage of mosquitoes has not been used for the identification of the species, probably because whole pupae mounted on microscope slides cannot be adequately studied and it is necessary to obtain pupal exuviae from specimens reared to adults. Few authors have worked specifically on pupae.

From an epidemiological point of view we consider it to be just as important to identify the species involved in the transmission of disease from the pupal stage as from the larval and adult stages because pupae are sometimes the only available individuals for the study of the populations. For this reason, the authors recently began the re-examination and description of pupae of Spanish mosquitoes (Melero-Alcibar, 2005; Melero-Alcibar & Molina, 2007).

*Dahlia geniculata* was described by Olivier (as *Culex geniculatus*) in 1791 and *Da. echinus* by Edwards (as *Ochlerotatus echinus*) in 1920, both as larvae. Later, different authors described the adult and its biology and

phenology (Marshall, 1938; Clavero, 1946; Natvig, 1948; Senevet & Anderelli, 1958; Gutsevich *et al.*, 1974). Only Clavero (1946), Senevet & Anderelli (1958) and Cranston *et al.* (1987) superficially described and partly illustrated the pupae of the species, in a short identification key. In the present paper the pupae of *Da. geniculata* and *Da. echinus* are revised and completely illustrated for the first time (Figures 1-2). A key is provided to identify the pupae of these species and *Da. gilcolladoi* (Villa, Rodríguez & Llera), *Ochlerotatus berlandi* (Seguy) and *Oc. pulcritarsis* (Rondani), all of which are found in tree holes in the Palearctic Region.

### Materials and methods

Specimens studied:

- Instituto de Salud Carlos III collection: *Da. geniculata*: 4 males, 2 females; *Da. echinus*: 8 males, 1 female.
- Larvae and pupae collected in a hole of *Platanus occidentalis* L. at “Casa de Campo” in Madrid province: *Da. gilcolladoi* (May-2005): 8 males, 14 females; *Oc. berlandi* (May 2005): 3 males.

- Larvae collected in a hole of *Quercus suber* L. at “El Acebrón” in Huelva province (March 2003): *Da. geniculata*: 4 males, 2 females; *Da. echinus*: 8 males, 1 female.

The larvae were reared in the laboratory to the pupal stage. Some pupae gave rise to adults, thus confirming the identification.

## Results and Discussion

The range and modal number of branches of each pupal seta are provided in Tables 1 and 2. Chaetotaxy and morphological descriptions used are in accordance with Harbach & Knight (1980).

Also, a short identification key for the phytotelmic pupae based on characters of the chaetotaxy is given for the first time. The key includes the five species of tribe Aedini mentioned above. Pupal specimens of *Oc. pulcritarsis* were not available for study, thus the chaetotaxy of this species is taken from Sicart (1951).

## Taxonomy

### *Dahlia geniculata* (Olivier)

*Cephalothorax* (Fig. 1A): **Setae 1-5,7-9-CT** long; **6-CT** short; **1-3-CT** usually single; **4-CT** with 2 branches; **5-CT** usually with 4 branches; **6-CT** single; **7-CT** bifurcate; **8-CT** usually with 2 or 3 branches; **9-CT** single.

*Trumpet* (Fig.1B): Strongly pigmented. Index 3.35–4.3.

*Metanotum* (Fig. 1C): **Setae 10-12-CT** long; **10,12-CT** with 4 branches; **11-CT** single.

*Abdomen* (Fig. 1C): **Seta 0-II-VIII** minute, single. **Seta 1-I** with 16-20 branches arising from short stem, **1-II-VII** moderately long, **1-II** usually with 5 branches, **1-III** with 2–4 branches, **1-IV** with 3 or 4 branches, **1-V-VI** usually double, **1-VII** single. **Seta 2-I-VII** moderately short, single. **Seta 3-I-III,V-VII** long, usually single, **3-IV** moderately short, usually triple. **Seta 4-I**, short, **4-II-IV**, moderately short, **4-V-VII** moderately long, **4-VIII** long, **4-I** pedunculate, with 2 or 3 branches, **4-II-IV,VI-VIII** usually single, **4-V** usually double. **Seta 5-I** short, pedunculate,

usually double, **5-II** moderately long, **5-III-V** very long, **5-VII** long, **5-VII** moderately short, **5-II-III,VI-VII** usually single, **5-IV** with single or double. **Seta 6-I-VII** long, **6-I** with 1 or 2 branches, **6-II-VII** single. **Seta 7-I,II** long, **7-V,VI,VII** moderately long, **7-III,IV** short, **7-I** usually single, **7-II** single, **7-III-V,VII** with 1 or 2 branches, **7-VI** single. **Seta 8-III-VII** short, **8-III-VI** usually double, **8-VII** with 1 or 2 branches. **Setae 9-I-VI** short, **9-VII,VIII** moderately long, **9-I-VI** single, **9-VII,VIII** usually double. **Seta 10-III-VII** long, **10-III** usually single, **10-IV-VII** single. **Seta 11-III-VII** short, single. **Seta 14-III-VIII** minute, single.

*Paddle* (Fig. 1C): Somewhat pear-shaped broadest distally, inner part slightly longer than outer part, apex emarginate at insertion of seta 1-Pa; margin of outer part aciculate from near base, inner part aciculate apically. Index 1.45-1.67, mode 1,62. Midrib weakly sclerotized. **Seta 1-P** moderately long, single.

### *Dahlia echinus* (Edwards)

*Cephalothorax* (Fig. 2A): **Setae 1-5,7-9-CT** long; **6-CT** short; **1-3-CT** usually single; **4-CT** with 2–4 branches, **5-CT** with 3 or 4 branches, **6-CT** double, **7-CT** usually bifurcate, **8-CT** usually with 3 or 4 branches; **9-CT** single.

*Trumpet* (Fig. 2B): Strongly pigmented. Index 2.9–4.5.

*Metanotum* (Fig. 2C): **Setae 10,12-CT** long; **10-CT** with 4 branches; **11-CT** single, **12-CT** with 3–5 branches.

*Abdomen* (Fig. 2C): **Seta 0-II-VIII** minute, single. **Seta 1-I** with 18–26 branches on basal one-third, **1-II-VII** moderately long, **1-II** usually with 7 branches, **1-III** with 3–5 branches, **1-IV** with 2–6 branches, **1-V,VI** usually double, **1-VII** usually single. **Seta 2-I-VII** moderately short, spine shaped, **2-I** usually double, **2-II-VII** single, **2-VI** usually single. **Seta 3-I-VII** long, **3-I,III,VI,VII** single, **3-II,V** usually single, **3-IV** usually triple. **Seta 4-I** short, **4-II-IV,VI** moderately short **4-V,VII** moderately long, **4-VIII** long, **4-I** pedunculate, with 2 or 3 branches, **4-II** usually with 3 branches, **4-III-,V** usually single, **4-V** usually

**Table 1:** Branching of setae on pupae of *Da. geniculata* (range with mode in parentheses).

Cephalothorax		Abdominal segments								Paddle
Seta	CT	I	II	III	IV	V	VI	VII	VIII	Pa
0			1	1	1	1	1	1	1	
1	1,2 (1)	16–20 (18)	5–7 (5)	2–4 (3)	3–4 (3)	2,3 (2)	1,2 (2)	1		1
2	1	1	1,2 (1)	1	1	1	1	1		
3	1	1	1	1	3,4 (3)	1	1	1		
4	2	2,3 (2)	1–3 (1)	1,2 (1)	1	1–3 (2)	1,2 (1)	1	1	
5	4,5 (4)	2,3 (2)	1,2 (1)	1,2 (1)	1,2 (2)	1	1	1		
6	1	1,2 (1)	1	1	1	1	1	1		
7	2	1,2 (1)	1	1,2 (2)	1,2 (1)	1,2 (1)	1	1,2 (1)		
8	2,3 (2)			2	1,2 (2)	2	1–3 (2)	1,2 (2)		
9	1	1	1	1	1	1	1	1,2 (2)	1–3 (2)	
10	4			1,2 (1)	1	1	1	1		
11	1			1	1	1	1	1		
12	4									
13										
14				1	1	1	1	1	1	

**Table 2:** Branching of setae on pupae of *Da. echinus* (range with mode in parentheses).

Cephalothorax		Abdominal segments								Paddle
Seta	CT	I	II	III	IV	V	VI	VII	VIII	Pa
0		1	1	1	1	1	1	1	1	
1	1	18–26 (20)	5–8 (7)	3–5 (4)	2–6 (3)	2,3 (2)	1–3 (2)	1–3 (1)		1
2	1,2 (1)	2,3 (2)	1	1	1	1	1,2 (1)	1,2 (1)		
3	1	1	1,2 (1)	1	2–4 (3)	1,2 (1)	1	1		
4	3,4 (2)	2,3 (3)	1–4 (3)	1,2 (1)	1,2 (1)	2–4 (3)	2,3 (2)	1	1	
5	3,4 (4)	2–4 (3)	1,2 (2)	1,2 (1)	1–3 (1)	1	1	1,2 (1)		
6	2	1	1	1,2 (1)	1	1	1	1,2 (1)		
7	2	1,2 (1)	1,2 (1)	2,3 (2)	2,3 (2)	2,3 (3)	1–3 (1)	1,2 (1)		
8	2–4			1	2,3 (2)	2	2–4 (3)	1–3 (2)		
9	1	1	1	1	1	1	1	1–5 (2)	2,3 (2)	
10	4			1,2 (1)	1,2 (1)	1	1	1		
11	1			1	1	1	1	1		
12	3–5 (4)									
13										
14				1	1	1	1	1	1	

triple, 4-VI usually double, 4-VII,VIII single. **Seta 5-I** short, pedunculate, usually triple, 5-II–V very long, 5-VI long, 5-VII moderately long, 5-II usually double, 5-III,IV,VII usually single, 5-V,VVI single. **Seta 6-I–VII** long, 6-I,II,IV–VI single, 6-III,VII usually single. **Seta 7-I,II**, long, 7-VI,VII moderately long, 7-III–V short, 7-I,II,VI,VII usually single, 7-III,IV usually double, 7-V with 2 or 3 branches. **Seta**

**8-III–VII** short; **8-III** single, 8-IV,VII usually double, **8-V** double, **8-VI** with 2–4 branches. **Setae 9-I–VI** short, **9-VII,VIII** moderately long, **9-I–VI** single, **9-VII,VIII** usually double. **Seta 10-III–VII** long, **10-III,IV** single or double, setae **10-V,VI,VII** single. **Seta 11-III–VII** short, single. **Seta 14-III–VIII** minute, single.

*Paddle* (Fig. 2C): Somewhat rectangular, broad at apex and emarginate; marginal areas of inner and outer parts strongly spiculate.

Index 1.5-1.8, mode 1.5. Midrib weakly sclerotized. **Seta 1-P** moderately long, single.

## IDENTIFICATION KEY FOR PUPAE OF PHYTOTELMIC SPECIES OF PALAEARCTIC MOSQUITOES

1. Seta 9-VIII usually with 4 or more branches; paddle sub-ovoid, not emarginate . . . . . 2
  - Seta 9-VIII moderately branched (fewer than 2 or 3 branches); paddle ovoid, emarginate . . . . . 3
- 2(1). Seta 9-VII bifurcated . . . . . *Oc. pulchritarsis*
  - Seta 9-VII usually single . . . . . *Oc. berlandi*
- 3(1). Seta 5-VII double; setae 4-V usually single . . . . . *Da. gilcolladoi*
  - Seta 5-VII usually single; seta 4-V double or triple . . . . . 4
- 4(3). Seta 5-II double, longer than segment; seta 2-I usually trifurcate; seta 7-V usually with 3 branches, short . . . . . *Da. echinus*
  - Seta 5-II usually single and short; seta 2-I usually single; setae 7-V usually single and moderately long . . . . . *Da. geniculata*

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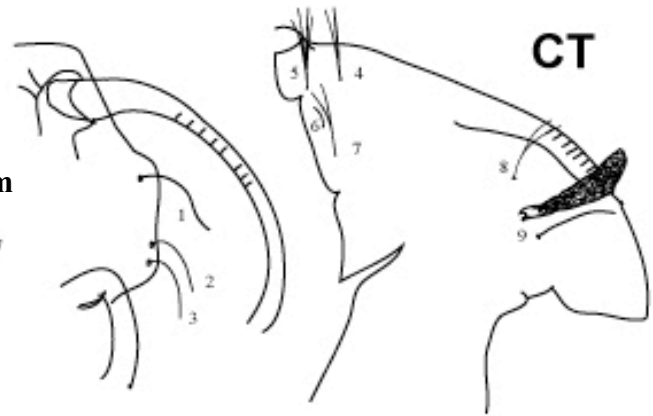
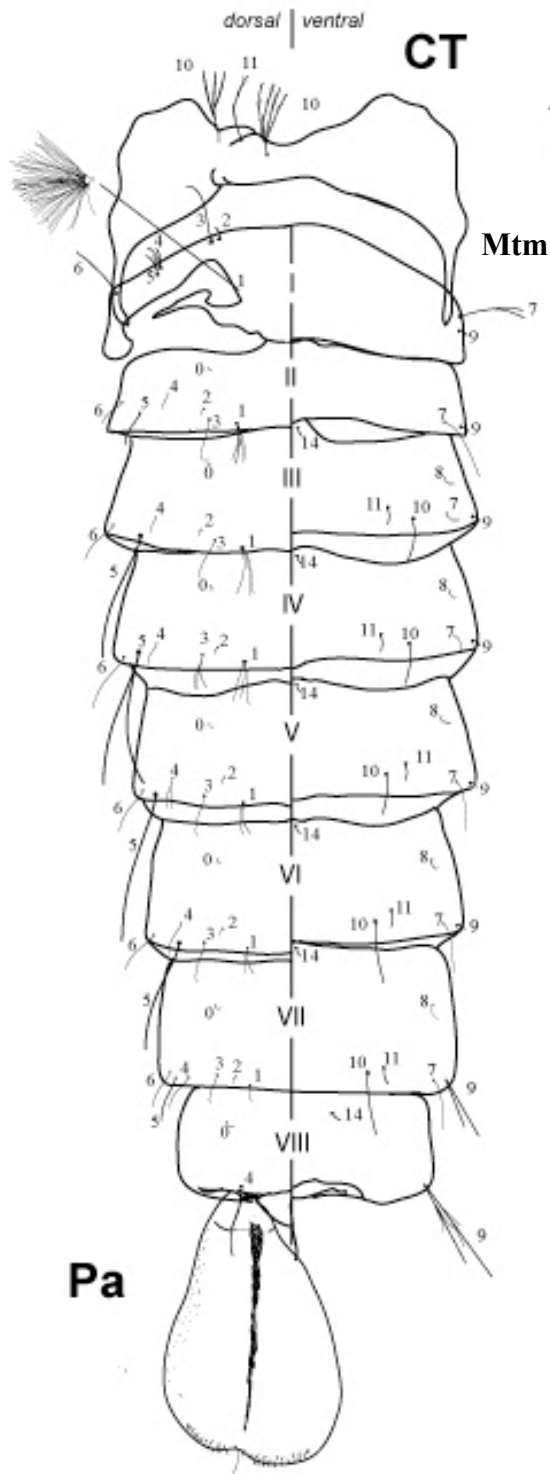


FIG. A

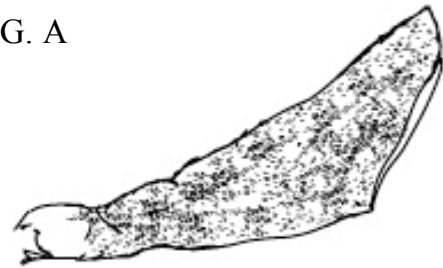


FIG. B

FIG. C

Figure 1. Pupa of *Dahliana geniculata*. A. Cephalothorax (CT); B. Trumpet; C. Metanotum (Mtm), abdomen (segments I-VIII) and paddle (Pa).

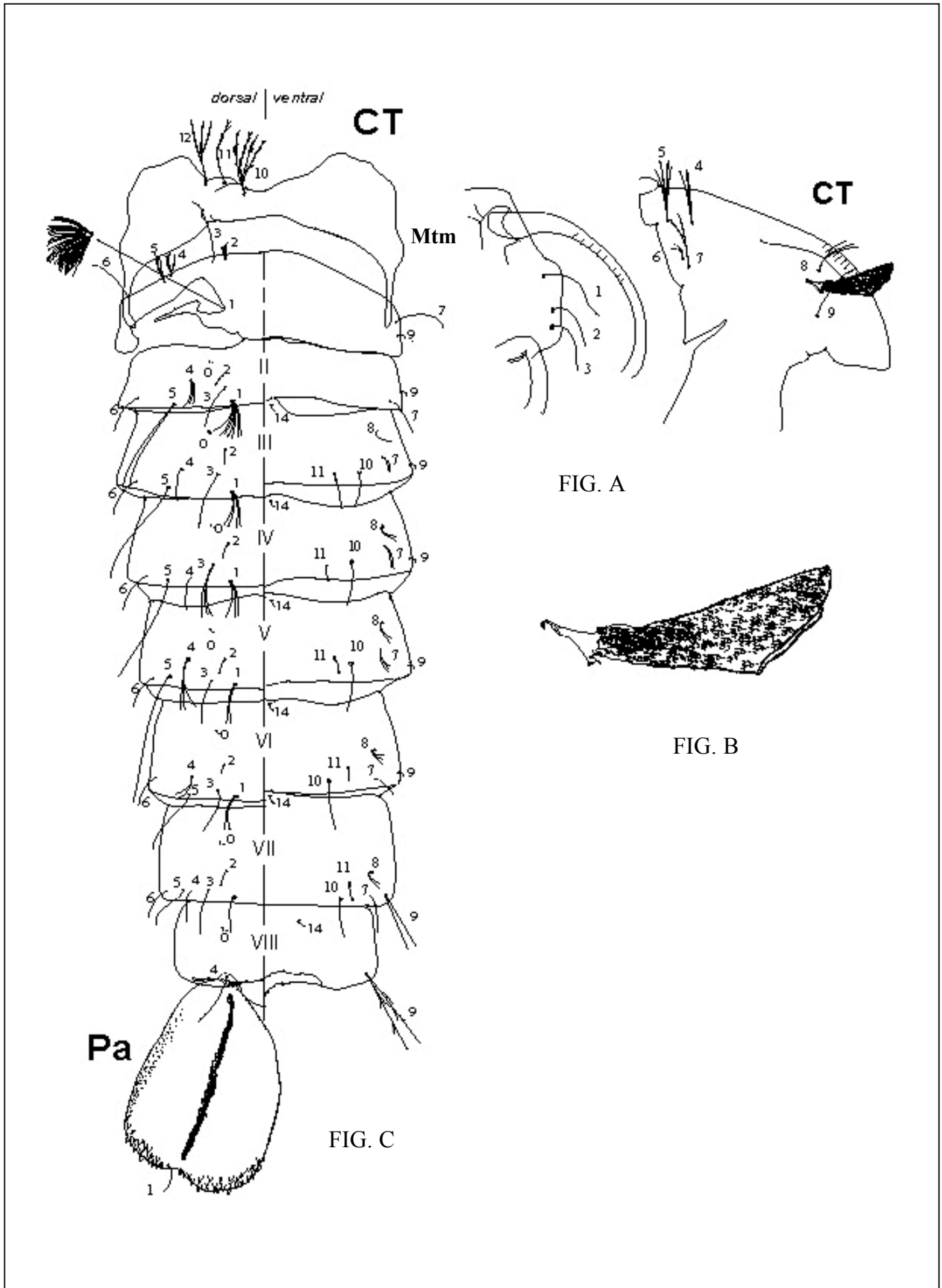


Figure 2. Pupa of *Aedes echinus*. A. Cephalothorax (CT); B. Trumpet; C. Metanotum (Mtm), abdomen (segments I-VIII) and paddle (Pa).