

**THE LARVA OF *DYTHEMIS MAYA* CALVERT, 1906 AND
A REDESCRIPTION OF THE LARVA OF *D. STERILIS* HAGEN, 1861
WITH A KEY TO THE LARVAE OF THE GENUS
(ANISOPTERA: LIBELLULIDAE)**

R. NOVELO-GUTIÉRREZ¹ and E. GONZÁLEZ-SORIANO²

¹ Departamento de Entomología, Instituto de Ecología, A.C., Apartado Postal 63, MX-91070 Xalapa, Veracruz, México – e-mail: novelor@ecologia.edu.mx

² Departamento de Zoología, Instituto de Biología, UNAM, Apartado Postal 70-153, MX-04510 México, D.F., México – e-mail: esoriano@ibunam.ibiologia.unam.mx

Received September 10, 2003 / Revised and Accepted February 16, 2004

The last instar larva of *D. maya* is described and illustrated for the first time, based on reared material from Hidalgo, Morelos and Michoacan States, Mexico. The larva of *D. maya* is the largest of the genus and is remarkably different from other larvae, mainly by the reduced or wanting dorsal protuberances, and in the short lateral spines on the abdomen. A redescription of the larva of *D. sterilis* and some notes on other larvae of *Dythemis* are also provided, and all species are keyed.

INTRODUCTION

Dythemis Hagen, 1861 is a neotropical genus with seven species (BRIDGES, 1993), six of which have been described in the immature stage – *D. fugax* Hagen, 1861 (NEEDHAM, 1904, non-reared), *D. multipunctata* Kirby, 1894 (DE MARMELS, 1982), *D. nigrescens* Calvert, 1899 (YOUNG & BAYER, 1979), *D. rufinervis* (Burmeister, 1839) (KLOTS, 1932 by supposition), *D. sterilis* Hagen, 1861 (GEIJSKES, 1946 by supposition), and *D. velox* Hagen, 1861 (NEEDHAM & COCKERELL, 1903, non-reared; NEEDHAM, 1904, non-reared).

Here we describe the larva of *Dythemis maya* Calvert, the only larva of the genus hitherto unknown, based on material from Hidalgo, Morelos and Michoacan States, Mexico; the description is based on last instar larvae and exuviae, one of these from a recently emerged adult. The larva of *D. sterilis* Hagen is redescribed based on reared individuals from Veracruz State, Mexico. GEIJSKES (1946) described the larva of this species by supposition based on non-reared younger individuals (one specimen was a

F-2 instar). For comparison, we describe some features of *D. multipunctata* Kirby and *D. nigrescens* Calvert not mentioned in their original larval descriptions, and provide a key to all 7 species.

DYTHEMIS MAYA CALVERT

Figures 1-9

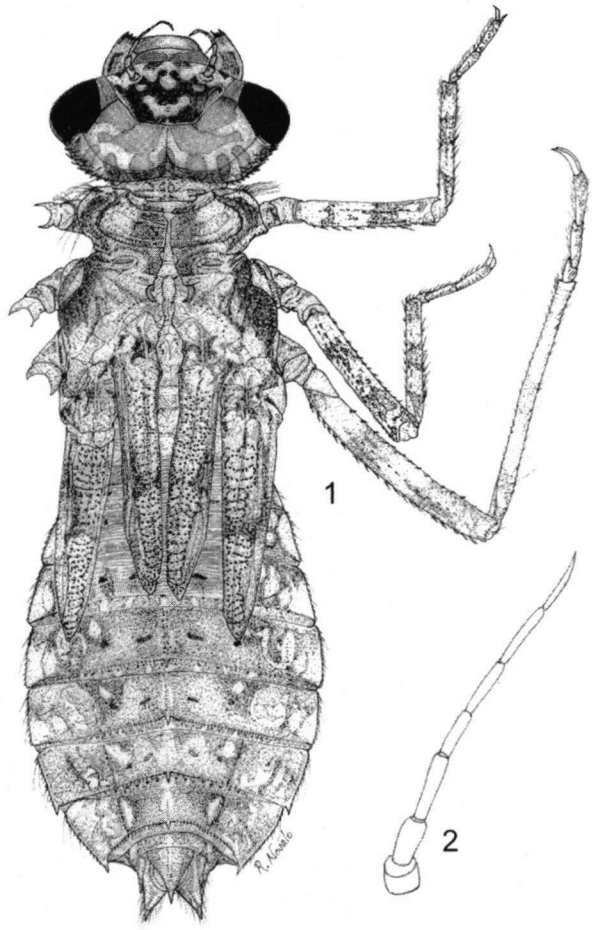
Material. — 4 exuviae (2♂, 2♀), 6 last instar larvae (♀). MEXICO: Hidalgo State, Zimapán, Río San Francisco, 20°34'N, 99°38'W (1650 m asl), 18-IV-1996, R. Novelo leg. (1♂ emerging); Michoacán State, Villa Victoria, 18°45'103"N, 103°22'680"W (680 m asl), 17-V-2002, R. Novelo leg. (1♀), deposited at IEXA, Xalapa, Mexico; Morelos State, Ajuchitlán, Arroyo Los Idolos, 18°28'065"N, 98°59'546"W (950 m asl), 8-VII-1996, E. González leg. (7♀, 1♂), deposited at CNIN, UNAM.

DESCRIPTION. — Larvae dark brown, with a complex pattern of obscure and light bands, spots and dots, poorly setose (Fig. 1). Exuviae light brown, color pattern as in larvae but less evident.

Head almost twice as wide as long, cephalic lobes rounded, not bulging, with large stout setae, occiput almost straight, slightly concave at middle, postocciput with a dense brush of long setae; anterior margin of frons with a row of long, delicate setae, remainder of head glabrous. Antennae 7-segmented (Fig. 2), the third the longest and the first the shortest; relative size of antennomeres: 0.6, 0.7, 1.0, 0.7, 0.9, 0.9, 0.9; basal half of flagellomeres 3-6 dark brown, apical half yellow and with long, delicate, sparse setae, 7 wholly dark brown. Labrum mostly smooth, setose on apical 0.25, clypeus quite glabrous. Mandibles (Fig. 3) with four incisor cusps, an additional small cusp at base of ventral cusp on right mandible, molar area with three low blunt cusps (Fig. 3a), and two low blunt cusps (Fig. 3b) on right and left mandibles, respectively. Maxilla: Galeolacinia with seven teeth, three long slightly incurved teeth on dorsal margin, three short slightly incurved teeth on ventral margin, apical tooth largest; maxillary palp little shorter than galeolacinia, ending in a robust blunt spine. Labium: Prementum-postmentum articulation reaching anterior margin of metasternum; prementum sub-rhomboidal (Fig. 4), with 8+4, 8+5, 8+6, 9+4, 9+5 or 9+6 long setae (usually 8+4), the two or three central setae the longest, lateral margins sinuate, widening to distal margin, then abruptly widened at apical 0.30; a group of 15-17 small spiniform setae on laterodorsal middle third, 4-5 short, stout spiniform setae on the base of palp articulation; ligula prominent (Fig. 4), its distal margin finely serrulated, with 18-20 short setae, two of them at tip; labial palp (Figs 4, 5a) with 8-11 (usually 10) long setae, 6-7 minute setae and one setella on basal internal surface, dorsal margin with a row of 16-18 small, stout, spiniform setae, distal margin with 8-9 crenulations moderately developed, each crenulation finely serrulated and with 3-5 stout spiniform setae on inner surface (Fig. 5b), external surface of palp mottled; movable hook long and slender.

Thorax. — Pronotal disc yellow, with a wide, longitudinal, dark brown band on middle third (Fig. 1), proepisternum yellow with a row of large spiniform setae intermingled with a dense brush of long setae on anterior margin, proepimeron dark brown

with a dense brush of long white setae on its ventral margin. Pronotum with a row of spiniform setae on anterior margin except at middle third, lateral margins widely rounded with short spiniform setae (Fig. 6) (the insertions of these setae are highly developed giving a granular aspect), posterior margin mostly smooth except for some spiniform setae and long delicate setae on posterolateral areas. Synthorax with a longitudinal, lateral, wide, dark brown band forked distally, remainder light brown, densely covered with minute spiniform setae. Legs long (i. e. when fully extended, hind legs surpassing the tip of abdomen), yellow, femora (distal ring poorly defined) and tibiae each with three dark rings (Fig. 1), a row of spini-

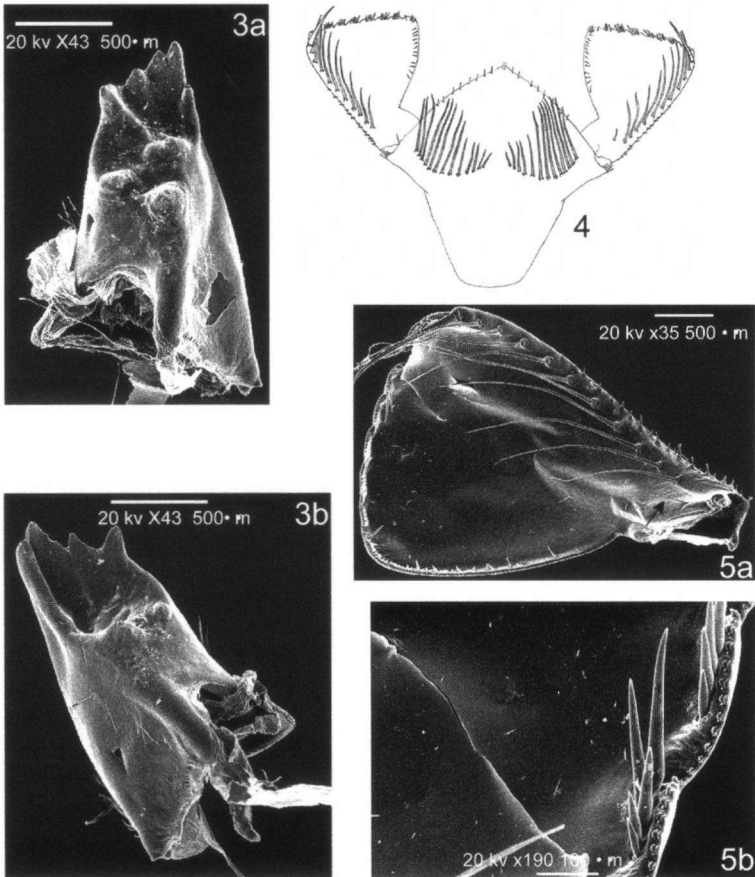


Figs 1-2. *Dythemis maya*: (1) last instar larva (left legs omitted); — (2) right antenna.

form setae on dorsal and ventral borders of femora, and on external and internal borders of tibiae, distal ends of tibiae with single and branched setae on internal surfaces (Fig. 7a); tarsi light brown, with two rows of spiniform setae on ventral margin, the internal row on fore- and hind tarsi with branched setae, the external row with unbranched setae (Fig. 7b), both rows on middle tarsi with branched setae; claws yellow. Wing pads light brown on basal 0.66, remainder yellowish; anterior wing pads reaching basal 0.50 of abdominal segment 6, posterior wing pads reaching posterior margin of 6.

A b d o m e n almost twice as long as its maximum width, sides convex, maximum width at segment 6, segments 1-5 pale on middorsal area, darker laterally, 6-10 brown

with a complex pattern of dark brown and yellow spots and dots; lateral margins of 4-9 with a row of small spiniform setae increasing in size and number posteriorly, ending in a small spine on 8-9 (Fig. 1), 0.2 and 0.4 as long as the middorsal length of its respective segment (dorsal length measured just lateral of the dorsal protuberance); dorsal protuberances on 3-9 as small acute spines (Fig. 8a), very uniform in size and height, that on 3 the smallest; posterior margins of tergites 2-5 with small delicate setae on middorsal area becoming spiniform on lateral areas, spiniform setae covering all the surface of 6-10; sternites smooth, except posterior margins of 7-10 which have a row of minute spiniform setae. Caudal appendages (Fig. 9): Epiproct and paraprocts pyramidal, sharply

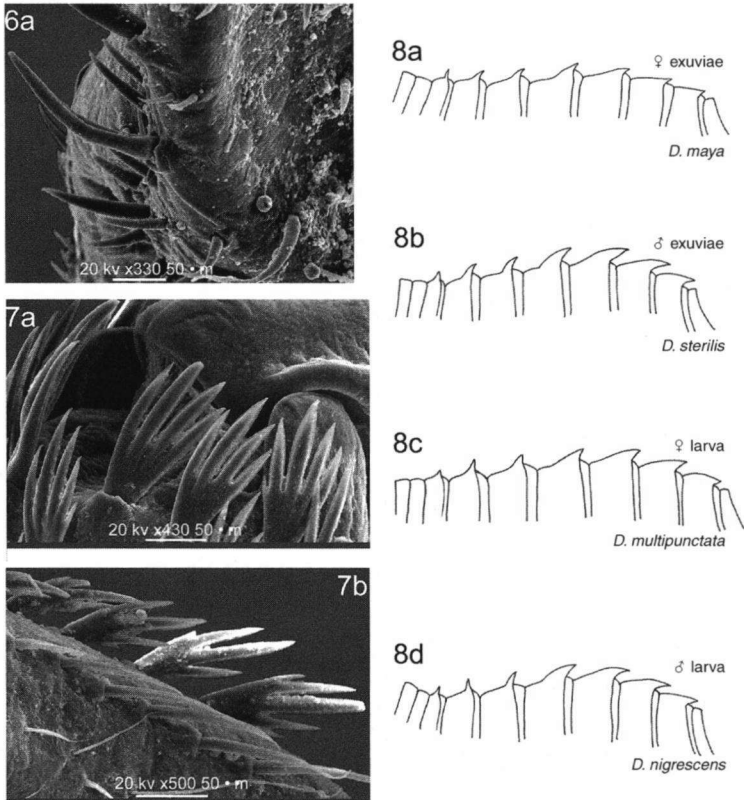


Figs 3-5. *Dythemis maya*: (3) mandibles: (a) right mandible, internal view, (b) left mandible, ventrointernal view; - (4) prementum; - (5) labial palp: (a) internal view of the right labial palp (arrow indicates setella), (b) detail of the palpal crenulations showing the fine serrulations on borders, as well as the stout spiniform setae on internal side.

pointed, with long, white setae on dorsal surface and lateral margins (epiproct), and on dorsal and ventral margins (paraprocts), spiniform setae on middorsal and ventral surface (epiproct), and on lateral margins (paraprocts); cerci digitiform, sharply pointed, smooth; relative size: epiproct 1.0, paraprocts 0.98, cerci 0.65 (0.62 in female); basal width of epiproct 0.80 its dorsal length.

Measurements (in mm). — Total length (including caudal appendages) 18-22; abdomen 10.2-13; hind femur (dorsal margin) 5.2-5.7; maximum width of head 5.2-5.9; maximum width of abdomen 5.7-7.1; epiproct 1.32-1.40, paraproct 0.93-1.23, cercus 0.68-0.89.

BIOLOGICAL NOTES. — Larvae were collected at a small pool formed downstream of a low waterfall in Morelos and Michoacan. In Morelos, two exuviae and one teneral adult were collected at the vertical rocky wall surrounding the pool. Males were seen perching on bushes and small trees surrounding the pool; aggressive interactions among males were commonly seen. Other odonates coexisting at the site were *E. semicircu-*



Figs 6-8. Details of the morphology of *Dythemis* larvae: (6) posterolateral border of pronotum of *D. maya* showing the stout, long setae; — (7) details of leg setae of *D. maya*: (a) four-branched setae on distal end of protibia, (b) single and branched setae on ventral border of foretarsus; — (8) profile view of abdominal tergites 1-10 showing dorsal protuberances on 3-9.

lare Selys, 1876, *Perithemis intensa* Kirby, 1889, and *Aeshna psilus* Calvert, 1947. In Hidalgo State, a male was found emerging on a bush at 11:18 h on a clear, sunny day at a pool situated in a secondary basin of a shallow stream.

DYTHEMIS STERILIS HAGEN

Figures 8b, 10-14

Material. — Exuviae (♂), 13 last instar larvae (5♂, 8♀), 2 young instars (♂). MEXICO: Veracruz State, Tlapacoyan, Ixtacuaco 20°03'21"N, 97°05'30"W (100 m asl), 10-VII-2002, R. Novelo leg. (8♂, 8♀). Deposited at IEXA, Xalapa, México.

REDESCRIPTION. — Larvae and exuviae as described for *D. maya* except: Relative size of antennomeres: 0.5, 0.6, 1.0, 0.8, 0.9, 0.9, 0.9, basal 0.33 of 7th antennomere dark, remainder yellow. Labium: Prementum-postmentum articulation almost reaching posterior margin of mesosternum; prementum with 5+3, 6+3, 6+4 or 7+3 long setae (usually 6+3), a group of 10-12 small spiniform setae on laterodorsal middle third; labial palp with 7-8 long setae (usually 8), 7-9 basal minute setae on internal surface (no setella observed), dorsal margin with a row of 13-15 small, stout spiniform setae, distal margin with 8-9 crenulations most of them obsolete except the dorsal two or three which are moderately developed (Fig. 10), with 3-4 stout spiniform setae on the inner side of each crenulation.

Thorax. — Posterior margin of pronotum smooth at middle third, densely covered with spiniform setae on posterolateral areas (Fig. 11). Legs: Femora with three dark rings, the basal ring the darkest. Anterior wing pads reaching posterior margin of abdominal segment 6, posterior wing pads reaching basal 0.75 of segment 7.

Abdomen longer than its widest part (ratio 1:0.8), lateral margins of segments 2-9 with a row of spiniform setae (minute on 2-3) increasing in size and number posteriorly, ending in a large, strong spine on 8-9 (Fig. 12), those spines 0.6 and 0.9 as long as the middorsal length of its respective segment (dorsal length measured just aside of the dorsal protuberance); dorsal protuberances present on tergites 3-9 (Fig. 8b), small and upright on 3-4, strong, acute and backwardly directed spines on 5-9, those on 7-8 the longest; protuberances with abundant long setae on 3-5 and stout spiniform setae on 6-9 (Fig. 13); tergites 3-9, including their posterior margins, densely covered with small spiniform setae except at middle third of 3-5; sternites 1-5 smooth, 6 with some sparse, spiniform setae, 7-9 with abundant spiniform setae including posterior margins; a small, dark, oval spot to each side of midline on sternites 3-8; a subapical, lateral tuft of long, stiff, reddish brown setae on each side of sternite 9. Caudal appendages (Fig. 14): long reddish brown setae on dorsal surface and lateral margins of epiproct and on dorsal and ventral margins of paraprocts; relative size: epiproct 1.0, paraprocts 0.92, cerci 0.66 (0.52 in female); basal width of epiproct 0.70 its dorsal length.

Measurements (in mm). — Total length (including caudal appendages) 12.6-15.6; abdomen 7.3-9.5; hind femur (dorsal margin) 4.7-5.0; maximum width of head 4.5-4.8; maximum width of abdomen 4.9-5.8; epiproct 1.1-1.2, paraproct 1.0-1.1, cerci 0.6-0.7; length of dorsal protuberance on abdominal segment 6,

0.3-0.4; on 7, 0.6; on 8, 0.6-0.7; on 9, 0.3-0.4 (measured from the posterior margin of their respective tergite to the apex of the protuberance).

BIOLOGICAL NOTES. — Larvae were collected at the edges of a small open stream in standing water or in slowly flowing muddy-sandy areas. One male emerged in captivity on July 11, at 07:30 h.

DYTHEMIS MULTIPUNCTATA KIRBY

Figure 8c

Material. — 1 exuviae (♀, reared), 1 last instar larva (♀). MEXICO: Veracruz State, "Los Tuxtlas", Estación de Biología Tropical, Laguna Emilia, 18°34'N, 95°04'W, 28-VIII-1985, R. Novelo leg., deposited in IEXA, Xalapa, Mexico.

Head. — Relative size of antennomeres: 0.5, 0.6, 1.0, 0.8, 0.7, 0.7, 0.7. Labium: Prementum with 6+3 setae, labial palp with 7 setae. Abdomen: As described for *D. sterilis* except: dorsal protuberances on 3-5 small and upright, those on 6-9 stout and backwardly directed (Fig. 8c); sternites 1-4 smooth, 5 with some sparse, spiniform setae, 6-9 with abundant spiniform setae including posterior margins; a small, dark, oval spot to each side of midline on sternites 4-8. Caudal appendages: Relative size: epiproct 1.0, paraprocts 1.0, cerci 0.58; basal width of epiproct 0.70 its dorsal length.

Measurements (in mm). — Total length (including caudal app.) 18.6; abdomen 11.8; hind femur (dorsal margin) 5.0; maximum width of head 5.0; maximum width of abdomen 5.5; epiproct 1.1, paraproct 1.1, cerci 0.6; length of dorsal protuberances on abdominal segment 6, 0.3; on 7, 0.4; on 8, 0.5; on 9, 0.2.

DYTHEMIS NIGRESCENS CALVERT

Figures 8d, 15-16

Material. — 4 exuviae (3♂, 1♀) (reared), 4 last instar larvae (2♂, 2♀). MEXICO: Morelos State, Tlaquiltengango, El Astillero, Río Cuautla (850 m asl), 5-II-1983, I. Oliva leg. (1♀); Ayala, San Juan Ahuehuevo (1150 m asl), 25-II-1985, R. Novelo leg. (3♂, 1♀ emerged 2/5-III-1985); Tlaltizapán, Las Estacas (980 m asl), 8-VII-1987, R. Novelo leg. (2♂); Xochitepec, Río Sabinos (1080 m asl), 5-IV-2002, R. Novelo leg. (1♀).

Head as described for *D. maya* except: Relative size of antennomeres: 0.5, 0.6, 1.0, 0.7, 0.9, 0.9, 0.9, 7th antennomere yellow. Labium: Premental setae 7+2, 7+3, 7+4, or 8+4 (usually 7+3), palpal setae 8-9 (usually 9).

Thorax. — Anterior wing pads surpassing posterior margin of abdominal segment 5, posterior wing pads reaching posterior margin of 6.

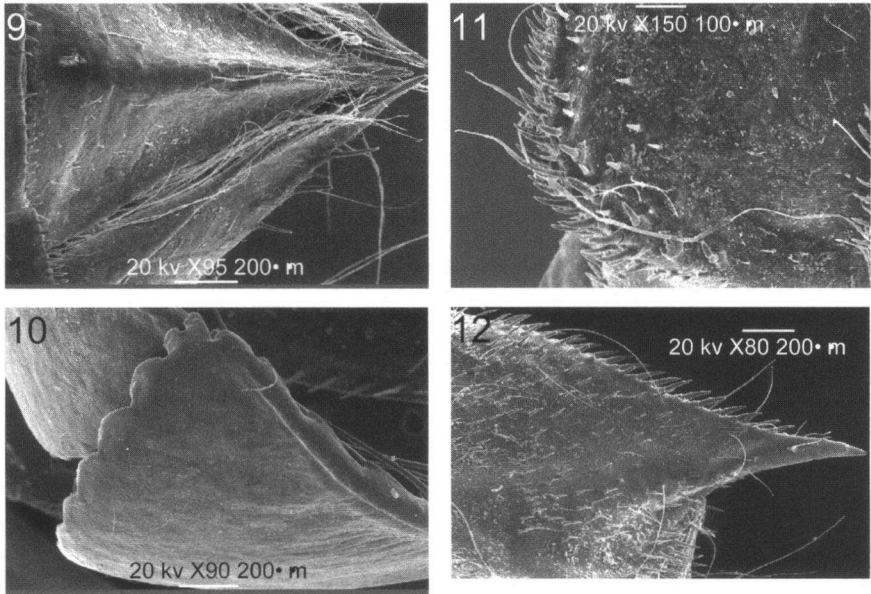
Abdomen. — The maximum width is reached at posterior margin of segment 6 (although YOUNG & BAYER, 1979, gave dimensions for segment 5, in their figure 4 it is clear that segment 6 is the widest). Lateral margins of 4-9 with small spiniform setae intermingled with small delicate setae, ending in a large, stout spine on 8-9 (Fig. 15), being 0.4 and 0.8 as long as the middorsal length of their respective segment; dorsal protuberances as described for *D. sterilis* but that on 3 small (Fig. 8d); tergites 2-10 as stated for *D. maya*; sternites 1-6 smooth, 7-9 with minute spiniform setae, scarce and

sparse on 7, abundant on 8-9 mainly on posterior margins, tufts of long setae on sternite 9 as those described for *D. sterilis* except yellowish colored. Relative size of caudal appendages (Fig. 16): Epiproct 1.0, paraprocts 1.0, cerci 0.66; basal width of epiproct 0.70 its dorsal length.

Measurements (in mm). — Total length (including caudal app.) 16.5-18; abdomen 9.9-10.4; hind femur (dorsal margin) 5.1-5.3; maximum width of head 4.9-5.0; maximum width of abdomen 5.7-5.9; epiproct 1.2, paraprocts 1.2, cerci 0.75-0.8; length of dorsal protuberances on segment 6, 0.4-0.5; on 7, 0.5-0.6; on 8, 0.5-0.6; on 9, 0.3-0.4.

DISCUSSION

The larva of *Dythemis maya* is remarkably different from other larvae of the genus by the following features: body size largest, length of legs (relative to the body's length) the shortest (eg., when fully extended, the tibiae of hind legs scarcely reaching the tip of anal pyramid), lateral spines on abdominal segments 8-9 the shortest in relation to the dorsal length of their respective segment, dorsal protuberances on tergites 3-9 reduced or absent. In this last respect, it is interesting to note that specimens of *D. maya* collected at Hidalgo and Michoacan States show dorsal protuberances on tergites 3-9 reduced, while those from Morelos State lack them completely except for that on tergite



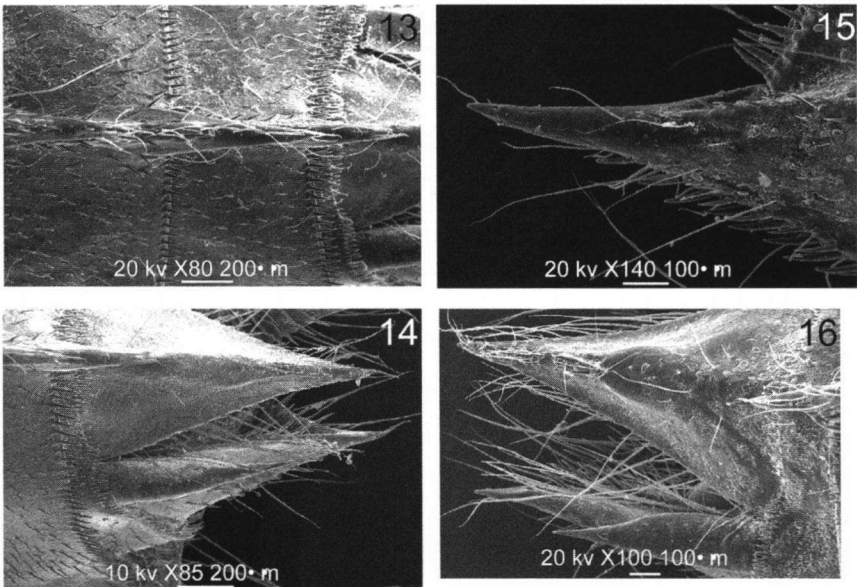
Figs 9-16. Details of the morphology of *Dythemis* larvae: (9) caudal appendages of *D. maya*, dorsal view, showing the long setae and the sharply pointed apices; — (10) frontodorsal view of left labial palp of *D. sterilis*, showing dorsal crenulations moderately developed, and remainder obsolete; — (11) posterolateral border of pronotum of *D. sterilis*; — (12) lateral margin of tergite 9 of *D. sterilis*, showing the spiniform setae and

3, and also on tergite 9 in some individuals.

Some inconsistencies arise between GEIJSKES's (1946) original description of the larva of *D. sterilis* and the redescription presented in this paper, probably due to the youth of the specimens Geijskes used. The main inconsistency is the relative size of antennomeres, which he stated as: "11, 13, 18, 16, 19, 22, 21", these numbers clearly indicating that 6th antennomere is the longest. However, in the four species treated in the present paper, we found the 3rd antennomere is the longest, as in many Odonata larvae, with the last 3 antennomeres of the same length. Other minor inconsistencies are related to body dimensions. Likewise, KLOTS (1932) mentioned that the larva of *D. rufinervis* has "dorsal hooks sharp and slender on segments 3-9, decreasing in size posteriorly, small on 9". We have not seen larvae of this species but in all other *Dythemis* larvae, the reverse is true: dorsal protuberances on 3-8 increase in size posteriorly, then decrease slightly on 9.

Besides having all the larvae of *Dythemis* known, it is important to point out that some of them were described from not fully grown larvae and non-reared individuals (*fugax*, *velox*), as well as by supposition (*rufinervis*) (see above). Thus, it remains as an important task to redescribe such species based on full-grown larvae and reared individuals.

Dythemis maya was reported by GONZÁLEZ & NOVELO (1996) as a species en-



the long caudal spine, dorsal view; – (13) middorsal area of abdominal tergites 8-10 of *D. sterilis*, showing the spiniform setae on posterior margins, as well as the dorsal protuberances of 7-9; – (14) anal pyramid of *D. sterilis*, dorsal view; – (15) detail of the posterolateral large spine on tergite 9 of *D. nigrescens*, dorsal view; – (16) anal pyramid of *D. nigrescens*, dorsal view.

demic to Mexico. However, in recent years, it has also been found in Texas, USA (ABBOT, 1996). In Mexico it is commonest in the states of the Pacific slope (from Sinaloa to Guerrero) although it also has been reported from Central Mexico and some states of the Gulf slope (GONZÁLEZ & NOVELO, 1996).

KEY TO THE *DYTHEMIS* LARVAE

(Modified from Needham et al., 2000)

- 1 Dorsal protuberances on abdominal segments 3-9 well developed (Figs 8b-d); premental setae 7-12 (occasionally some *fugax* with 13 setae) 2
 - Dorsal protuberances on abdominal segments 3-9 reduced (Fig. 8a) or wanting; premental setae 12-15 *maya*
- 2 Lateral spines on abdominal segment 9 equal to or shorter than the middorsal length of this segment ... 3
 - Lateral spines on abdominal segment 9 almost 1.3-1.5 times the middorsal length of this segment *fugax**
- 3 Larger species, metafemur usually longer than 5 mm; palpal setae 8-10 4
 - Smaller species, metafemur usually 5 mm or shorter; palpal setae 5-8 5
- 4 In lateral view dorsal margin of distal 0.5 of dorsal protuberances on abdominal segments 6 and 7 slanted distinctly upward, that of protuberance on segment 8 nearly straight and parallel to body axis *velox**
 - In lateral view dorsal margin of distal 0.5 of dorsal protuberances on abdominal segment 6 barely slanted upward, on segment 7 parallel to body axis, and on segment 8 distinctly curved downward (Fig. 8d) *nigrescens*
- 5 Lateral spines of abdominal segment 9 less than 0.5 middorsal length of segment; endemic to Greater Antilles *rufinervis**
 - Lateral spines of abdominal segment 9 more than 0.5 middorsal length of segment 6
- 6 In lateral view dorsal protuberance on abdominal segment 4 small and vertical, that on 7 reaching basal 0.25 of abdominal segment 8 (Fig. 8c) *multipunctata*
 - In lateral view dorsal protuberance on abdominal segment 4 large and curved to the rear, that on 7 reaching basal 0.50 of abdominal segment 8 (Fig. 8b) *sterilis*

Note: The asterisk (*) indicates that larvae were unavailable for examination.

ACKNOWLEDGEMENTS

We thank TIBURCIO LAEZ-APONTE (Xalapa) for the electron microphotographs. Biól. CESAR ROJAS-GÓMEZ made the final composition of the figures. Special thanks are due to Dr KEN J. TENNESSEN (Alabama) for his criticism of the final manuscript, and for some data on the larva of *D. fugax*.

REFERENCES

- ABBOT, J.C., 1996. New and interesting records from Texas and Oklahoma. *Argia* 8(4): 14-15.
- BRIDGES, C., 1993. *Catalogue of the family-group, genus group and species group names of the Odonata of the World*. [2nd edn]. Bridges, Urbana, IL.
- DE MARMELS, J., 1982. Cuatro náyades nuevas de la familia Libellulidae (Odonata: Anisoptera). *Boln Ent. venez.* (N.S.) 2(11): 94-101.
- GEUSKES, D.C., 1946. Observations on the Odonata of Tobago, BWI. *Trans. R. ent. Soc. Lond.* 97: 213-235.
- GONZÁLEZ-SORIANO, E. & R. NOVELO-GUTIÉRREZ, 1996. Odonata. In: J. Llorente, A.N. García & E. González, [Eds], *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una*

- síntesis de su conocimiento*, pp. 147-167, UNAM, México.
- KLOTS, E.B., 1932. Insects of Porto Rico and the Virgin Islands. Odonata or dragon flies. *Sci. Surv. Porto Rico Virgin Isls* 14: 1-107.
- NEEDHAM, J.G., 1904. New dragon-fly nymphs in the United States National Museum. *Proc. U.S. Natn. Mus.* 27: 685-720.
- NEEDHAM, J.G. & T.D.S. COCKERELL, 1903. Some hitherto unknown nymphs of Odonata from New Mexico. *Psyche* 10: 134-139.
- NEEDHAM, J.G., M.J. WESTFALL, Jr & M.L. MAY, 2000. *Dragonflies of North America*. Scient. Publr, Gainesville/FL.
- YOUNG, W.C. & C.W. BAYER, 1979. The dragonfly nymphs (Odonata: Anisoptera) of the Guadalupe River basin, Texas. *Texas J. Sci.* 31(1): 85-97.