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The larva of *Aphylla protracta* (Hagen, 1859), and a redescription of the larva of *A. angustifolia* Garrison, 1986 (Odonata: Gomphidae)

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Abstract

The larva of *Aphylla protracta* is described and figured. It is characterized by 3rd antennomere subcylindrical, flattened on ventral surface, 4.2 times longer than its widest part. Abdomen with dorsal protuberances well developed on S2–4, reduced on S5, vestigial or absent on S6–9; lateral spines lacking entirely, tergites 5–8 with minute reddish setae, tergite 9 with abundant, small, reddish setae on most of its surface and the whole posterior margin; S10 cylindrical, very long, five times longer than its base, much longer than S6+7+8+9. Also, a redescription and figures of *A. angustifolia* are provided, and a comparison of both species is made. Mainly differences between both species were found in abdominal dorsal protuberances and the presence/absence of small setae on abdominal tergites.

Key words: Anisoptera, larval description, Veracruz, Michoacán, Mexico

Resumen

Se describe e ilustra la larva de *Aphylla protracta*. Esta se caracteriza por tener el 3er antenómero subcilíndrico, aplanado ventralmente, 4.2 veces más largo que su mayor anchura. Abdomen con protuberancias dorsales bien desarrolladas en los S2–4, reducidas en S5 y vestigiales o ausentes en S6–9; sin espinas laterales, terguitos 5–8 con diminutas sedas rojizas, terguito 9 con sedas rojizas pequeñas y abundantes en la mayor parte de su superficie y en la totalidad del margen posterior; S10 cilíndrico, muy largo, cinco veces más largo que su anchura basal, más largo que S6+7+8+9. Asimismo, se proporciona la redescripción de *A. angustifolia*, y se hace la comparación de las dos especies. Las principales diferencias entre ambas especies se encontraron en las protuberancias dorsales del abdomen y en la presencia/ausencia de pequeñas sedas en los terguitos abdominales.

Palabras clave: Anisoptera, descripción larval, Veracruz, Michoacán, México

Introduction

The New World genus *Aphylla* comprises 24 species known to date (Garrison et al. 2006), most of them inhabiting South America. The larvae of only seven species have been described, six of them curiously by supposition and under other genera or species. According to Garrison (1986), the genus *Aphylla* is represented in Mexico by two species: *A. angustifolia* Garrison and *A. protracta* (Hagen). However, Novelo-Gutiérrez (2014) recently found a specimen of *A. tenuis* Selys in the state of Chiapas, raising to three the number of species of *Aphylla* for Mexico. Needham (1940) described, by supposition, the apparently penultimate instar larva of *A. angustifolia* as *A. protracta*. In this paper, a detailed description and illustrations of the true larva of *A. protracta* are provided, as well as a redescription of the larva of *A. angustifolia*, both from specimens reared to emergence.

Methods

Larvae were collected with a D-frame aquatic net and maintained alive until emergence in the laboratory; those

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died while rearing were preserved in 96% ethanol. Afterwards, they were transferred to vials containing 80% ethanol. Exuviae were picked up directly from grasses and soil and preserved in the field in 96% ethanol. Mandible nomenclature follows Watson (1956); labium nomenclature follows Corbet (1953). Drawings were made with the aid of a camera lucida on a stereomicroscope ZEISS Stemi SV 6. Photographs were obtained with a CANON PowerShot G10 digital camera mounted in a stereomicroscope ZEISS Stemi 2000-C. Measurements (in mm) were made with a calibrated ocular micrometer as follows: Head width, across compound eyes; total length, dorsally from anteriormost margin of labrum to tips of caudal appendages; abdomen length, ventrally to posteriormost margin of abdominal segment 10; hind femora, along midline of external surface. S1–10 indicates abdominal segments 1 to 10.

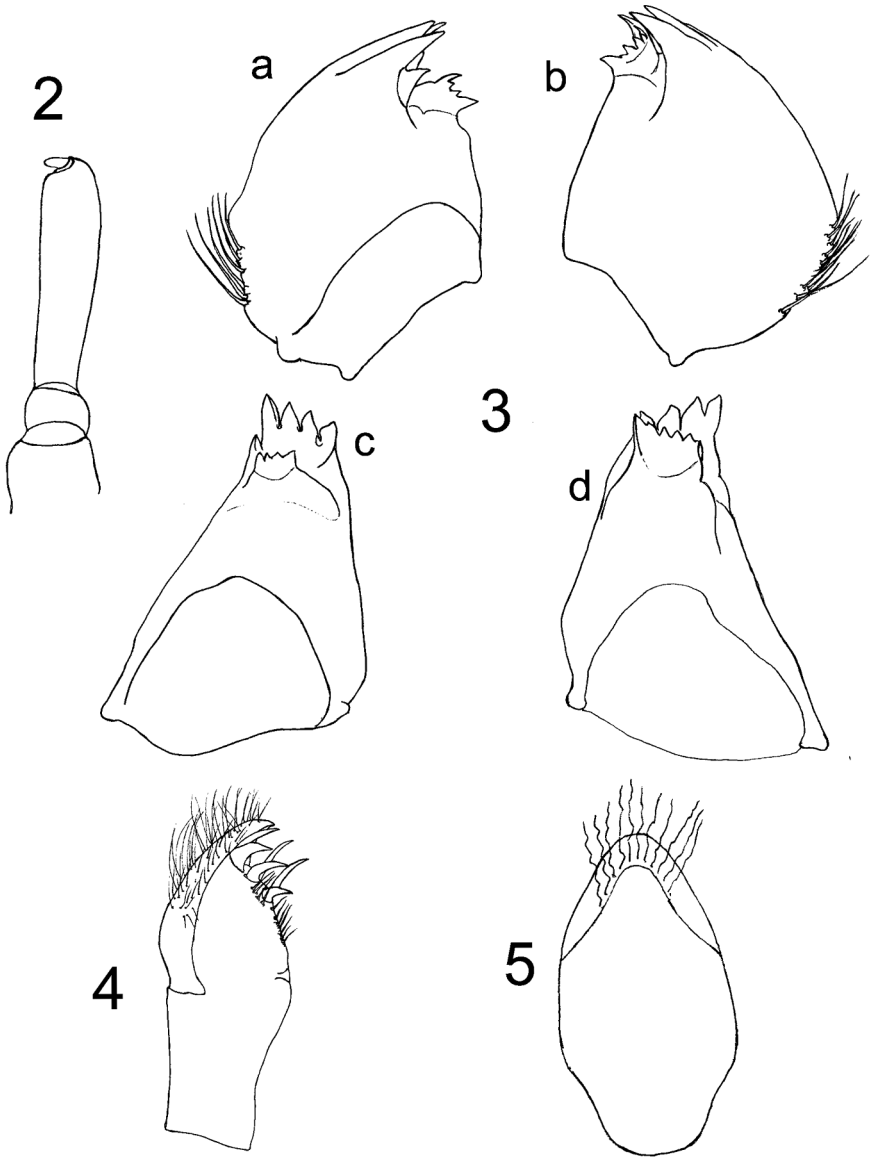
***Aphylla protracta* (Hagen)**
(Figs. 1–6, 7a,c, 8a, 9a, 10)

Material. Fifteen exuviae (9♂, 6♀, one ♂ reared), 7 F-0 larvae (3♂, 4♀). MEXICO: Michoacán; Municipality of Coahuayana, arroyo El Ticuiz (18° 40.403 N; 103° 40.601 W, elevation 10m asl, stream in highly disturbed tropical forest), 29 March 2005 (1♀), 01 June 2005, (2♂, one reared and emerged on 03 June 2005, 14 exuviae), 28 September 2005 (3♀), 20 January 2006 (1♂), 10 July 2006 (1♂), all J.A. Gómez, R. Novelo leg. All specimens deposited in Colección Entomológica del Instituto de Ecología, A.C., Xalapa (IEXA).

Description. Large larva (36.8–43.4 mm total length), body robust, setose on legs and sides of abdomen, strongly tapering caudad with abdominal segment 10 extremely elongated, coloration yellow (Fig. 1) to light yellow-brown, exuviae brown.

FIGURE. 1. Last stadium larva of *Aphylla protracta*. a) dorsal view, b) ventral view.

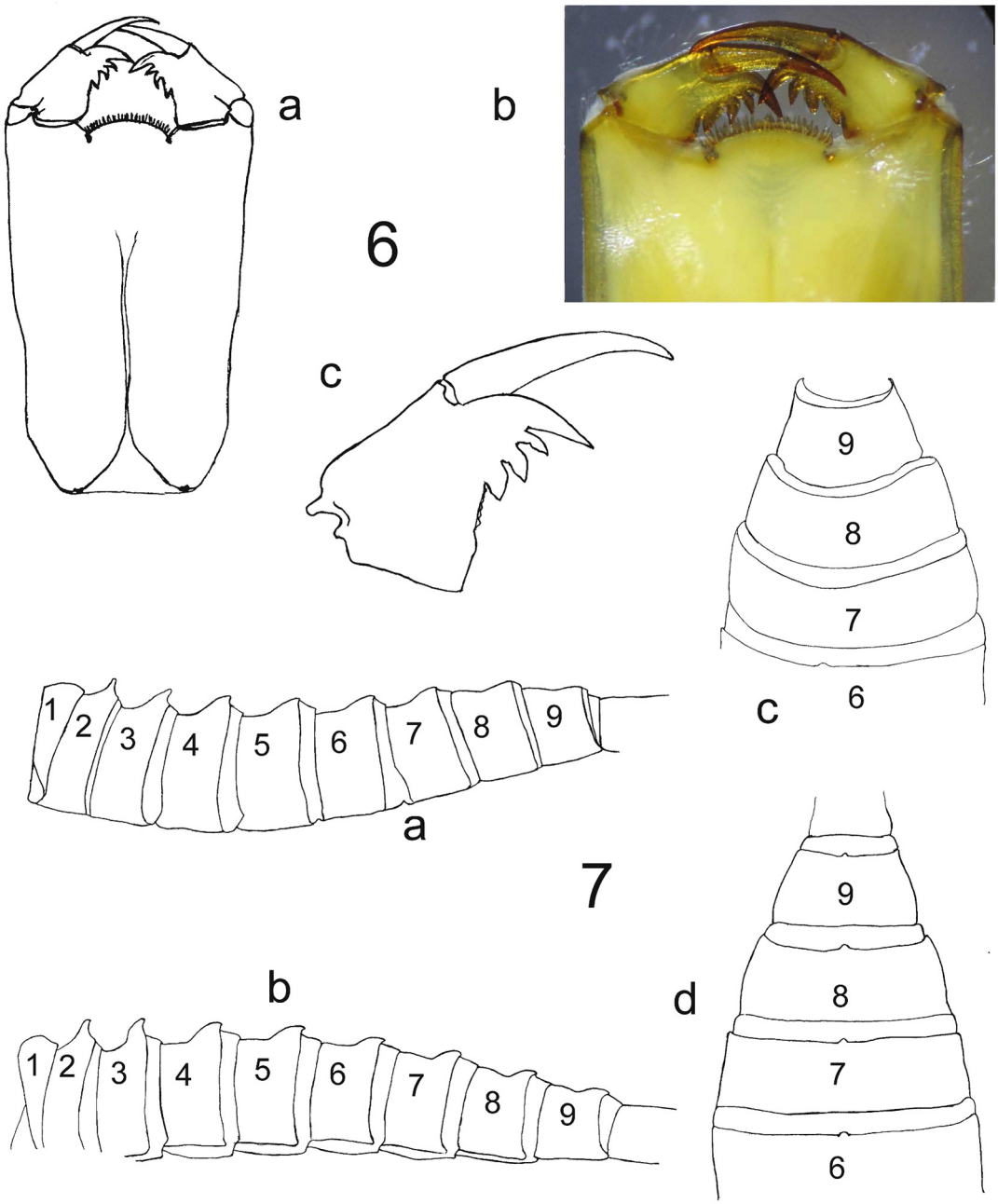
Head: Wider than long, but narrower than thorax and abdomen. Labrum 0.9 mm long, mostly bare, anterior border with dense brush of golden setae, flattened ventrally; clypeus, frons and vertex bare, a tuft of long, upturned, golden setae on frontolateral margins of frons (between antenna and the anterior margin of compound eye), occiput mostly bare, with long, golden setae on occipital lobes, anterior margin of frons slightly concave. Antennae 4-segmented (Fig. 2), densely covered with long, whitish setae on lateral margins, scape globose, pedicel subglobose, 3rd antennomere largest, subcylindrical, flattened on ventral surface, 4.2 times longer than its widest part, 4th antennomere reduced, digitiform, upturned; scape, pedicel and 3rd antennomere yellow, 4th antennomere brown, size proportions: 0.30, 0.22, 1.0, 0.12. Compound eyes moderately developed; ocelli creamy pale. Occipital lobes rounded, bulging. Mandibles (Fig. 3) with molar crest, formula: L 1234 0 a(m^{1-4})b / R 1234 y a($m^{1-2\ or\ 1-3}$)b, in both



FIGURES. 2–5. Details of the morphology of the larva of *A. protracta*. 2) Left antenna, dorsal view (setae omitted); 3) Mandibles: a and c, right mandible, b and d, left mandible (a and b, ventroexternal view, c and d, internal view); 4) Right maxilla showing palp and galeolacinia, ventral view; 5) Ventral pad of hypopharynx.

mandibles tooth a>b, tooth y in right mandible large, almost as large as incisors 2 and 3 (Fig. 3a). Maxillae: Galeolacinia (Fig. 4) with 7 moderately incurved teeth, three dorsal teeth more or less of same length and robustness, four ventral teeth of different size, apical one largest; maxillary palp thick and robust. Ventral pad of hypopharynx approximately diamond-shaped, withish, soft, with long, hirsute, stiff setae mainly toward rounded apex (Fig. 5). Labium: Prementum-postmentum articulation reaching posterior margin of procoxae. Prementum

(Figs. 1b, 6) yellow, 0.25 longer than its widest part, lateral margins smooth, straight at apical 0.60, slightly concave on basal 0.40 (Fig. 6a); a longitudinal, bare, central sulcus on basal 0.70 of ventral surface, ending distally in a large, shallow, concavity just below ligula; ligula very poorly developed (Fig. 6a), apical margin slightly convex, with a double row of short, stout piliform setae (Fig. 6b); labial palp stout (Figs. 6b and c), yellow, with some sparse long, white, delicate setae on ventral and external surfaces, apical lobe reddish, sharp, stout, strongly incurved, internal margin with 3–4 robust, conical teeth, very basal part of this margin with a finely serrate border; movable hook yellowish-red, almost as long as palp, sharp and moderately incurved.



FIGURES. 6–7. Details of the morphology of *Aphylla* spp. larvae. 6) Prementum: a, ventral view; b, ligula and palps, dorsal view; c, right palpus, ventral view. 7) Abdomen: a and b, left lateral view of segments 1–9 showing the profile of the dorsal protuberances; c and d, dorsal view of tergites 6-9 showing the reduced or absent dorsal protuberances (Figs. 6, 7a and c, *A. protracta*; Figs. 7b and d, *A. angustifolia*).

Thorax: Prothorax slightly narrower than head, setose on inferior border. Anterior margin of pronotum slightly concave, lateral margins convex, posterior margin sinuate. Synthorax mostly bare, with some tufts of long, curled setae on inferior margins, meso- and metaspiracles evident. Legs very short (e.g.: when fully extended, hind legs

scarcely reaching anterior margin of abdominal segment 6), strongly setose, with long, whitish, delicate setae mainly on sides, and shorter, stiff, yellow setae mainly on anterior surfaces of pro- and mesotibiae and on external surfaces of pro- and mesotarsi; burrowing hooks moderately developed (Fig. 1); femora and tibiae of hind legs of the same length; claws simple, without a pulvilliform empodium. Anterior wing pads slightly divergent, posterior wing pads parallel, with abundant, delicate setae on margins and minute setae along primordial veins, remainder of surface mostly bare; anterior and posterior wing pads reaching basal half and posterior margin of abdominal segment 4, respectively.

Abdomen: Yellow, enlarged, tapering caudad (Fig. 1a), ventral surface more or less flat (Fig. 1b), dorsal surface convex, with dorsal protuberances (Fig. 7) well developed on S2-4, reduced on S5, vestigial or absent on S6–9, lacking on S10, all of them covered with abundant, small, stiff, reddish setae, those on S2–3 erect, vertical Fig. 7a); lateral spines lacking entirely; tergites 2–4 with combined short and long, delicate setae, tergites 5–8 with minute reddish setae, mainly on middle third of posterior margins, tergite 9 with abundant small, reddish setae on most of its surface and entire posterior margin; lateral margins of S2–9 and entire surface of S10 densely setose; tergites 2–8 with a sublateral, mound-like protuberance on each side of midline, at midlength of each tergite; S10 cylindrical (Fig. 1), reddish-brown, very long, five times longer than its base, much longer than S6+7+8+9. Sternites 1–9 light yellow (Fig. 1b), sternite 10 reddish-yellow; sternites 1–7 and 9 divided into three plates, sternite 8 divided in five plates (Fig. 8a), ventral sutures parallel on 2–8, slightly divergent caudally on 9; sternites 2–8 with three transversal, subbasal swellings (lumps), one in the midline, other two to each side of central one. Male gonapophyses lacking; female gonapophyses reduced, trapezoid, widely truncate at apex, internal margins widely divergent, V-shaped, almost twice wider than long (Fig. 9a). Caudal appendages (Fig. 10) very short, pyramidal, covered with abundant, small, stiff setae, cerci reddish-brown, sharply-pointed, epiproct and paraprocts mostly creamy pale, epiproct wide at base and strongly narrowed at apical half, as long as cerci but slightly shorter than paraprocts.

Measurements (range followed by mean**).** Last instar larvae (N= 7); Total length (TL) (incl. caudal app.) 36.8–43.4, 40.1; abdomen (Ab) (ventral, excl. caudal app.) 25.6–32, 28.6; maximum width of head 5.3–5.5, 5.4; hind femur (Hf) (lateral) 4.3–4.5, 4.4; segment 10 (S10) (ventral, excl. caudal app.) 9.3–11.2, 10.2; epiproct (Ep) 0.9, cerci (Ce) 0.9, paraprocts (Pp) 0.9–1.0, 0.98. Exuviae (N= 15): TL 39.7–45.2, 43.2; Ab 29.5–33.7, 32.2; Hf 4.2–4.7, 4.4; S10 9.5–12, 11.0; Ep 0.8–0.9, 0.87, Pp 0.8–1.0, 0.95, Ce 0.8–0.9, 0.87.

Habitat. Larvae of this species were found in both lotic and lentic water bodies, at muddy edges of sluggish streams with abundant grasses and patches of *Eichhornia crassipes* (Mart.), and at the shoreline of lagoons.

Aphylla angustifolia Garrison

(Figs. 7b,d, 8b, 9b, 11)

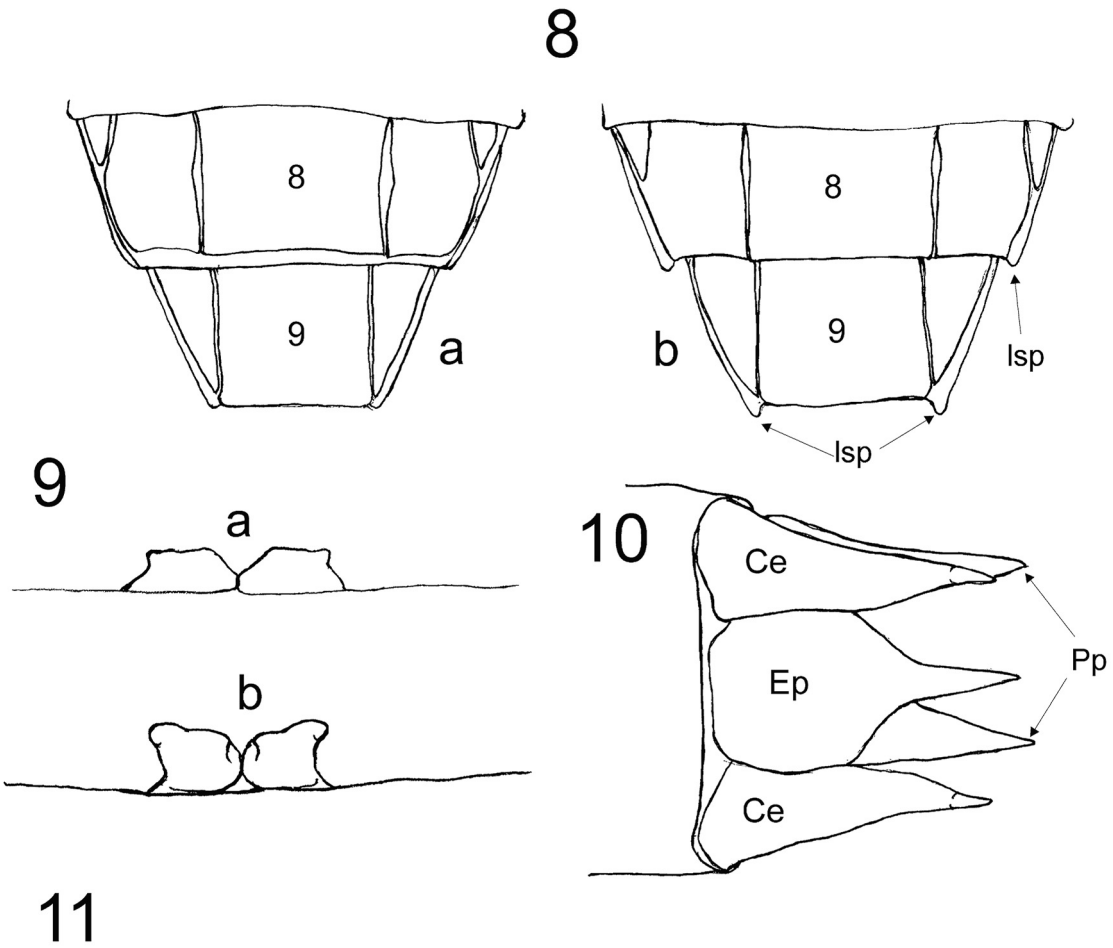
Needham, 1940. *Trans. Amer. Ent. Soc*. Larval description as *A. protracta* by supposition.

Material. Three exuviae (1♂, 2♀ , one ♂ reared), 2 ♂ F-0 larvae, 4 probably F-3 larvae. MEXICO: Veracruz; Municipality of Xalapa, Laguna del Castillo (19° 32.434 N; 96° 51.594 W, altitude 1,148m asl, lagoon in highly disturbed oak forest), 25 September 1993, R. Arce leg (1♂); Municipality of Sayula de Alemán, Almagres (17° 48.272 N; 94° 55.305 W, altitude 44m asl, lagoon in highly disturbed tropical rain forest), 20 March 1999, J.A. Gómez leg (2 ♀ exuviae, 4 young larvae); Municipality of Emiliano Zapata, Laguna Miradores (19° 28.278 N; 96° 47.197 W, altitude 930m asl, lagoon in highly disturbed thorn forest), 11 May 1999, J.A. Gómez, R. Novelo leg (2♂, one emerged 13 May 1999). All specimens deposited at Colección Entomológica del Instituto de Ecología, A.C., Xalapa (IEXA).

Redescription. Very similar to *A. protracta* with the following differences:

Head: Third antennomere 5 times longer than its widest part, not conspicuously flattened on ventral surface, slightly upturned on apical 0.30 in profile view; size proportions of antennomeres: 0.26, 0.16, 1.0, 0.10. Left mandible with formula: L 1234 0 a(m^{1-7})b.

Abdomen: Dorsal protuberances reduced on S5–9 (Fig. 7b) but clearly visible as triangular projections in dorsal view (Fig. 7d). Lateral margins of S8–9, ending in a vestigial spine with a round tip. Dorsal surface of S2–9 mostly smooth, with small white, stiff setae restricted to the dorsal protuberances, and long, abundant, delicate white setae on lateral margins. Female gonapophyses apically bilobed with external lobe largest (Fig. 9b). Caudal appendages: Epiproct reddish-brown.



FIGURES. 8–11. Details of the morphology of *Aphylla* spp. larvae. 8) Sternites 8–9 showing the 5 plates in sternite 8 and 3 plates in sternite 9, and the absence (a) or presence (b) of lateral spines on S8–9. 9) Female gonapophyses, ventral view. 10) Male caudal appendages, dorsal view: Ce, cercus, Ep, epiproct, Pp, paraproct. 11) Exuvia in natural habitat (Figs. 8a, 9a, 10, *A. protracta*, Figs. 8b, 9b, 11, *A. angustifolia*).

Measurements (range followed by mean**).** Last instar larvae (N= 2): Total length (TL) (incl. caudal app.) 38.2–39, 38.6; abdomen (Ab) (ventral, excl. caudal app.) 26.6–27.7, 27.1; maximum width of head 5.2; hind femur (Hf) (lateral) 4.1–4.3, 4.2; segment 10 (S10) (ventral, excl. caudal app.) 8.8–9.5, 9.1; epiproct (Ep) 0.9, cerci (Ce) 0.9, paraprocts (Pp) 1.0. Exuviae (N= 3): TL 43.4–48.5, 45.3; Ab 31.5–35.8, 33.1; Hf 4.3–4.6, 4.5; S10 10.5–12.8, 11.6; Ep 0.8–0.9, 0.87, Pp 0.9–1.0, 0.97, Ce 0.8–0.9, 0.87.

Habitat. Found in lentic environments such as ponds and lagoons, at muddy edges; also in pools of intermittent streams (Needham et al. 2014).

Discussion

Morphologicaly, the larvae of *Aphylla protracta* and *A. angustifolia* are very similar, although they can be separated under close inspection by the following features (in parentheses those of *A. protracta*): Third antennomere 5 times longer than its widest part (4.2 times); abdominal dorsal protuberances reduced on S6–9 (vestigial or absent on S6–9); abdominal tergites 5–9 mostly lacking minute reddish setae including posterior margins (tergites 5–8 with some minute reddish setae, mainly on middle third of posterior margins, tergite 9 with abundant, small, reddish setae on most of its surface and entire posterior margin). Moreover, F-0 larvae of *A. protracta* appear larger in stature, with 36.8–43.4 mm of total length (38.2–39 mm in *A. angustifolia*). On the other hand, Needham et al. (2014, p. 128), in their key to *Aphylla* larvae, stated the presence of "three teeth before end hook" as a feature for the separation of *A. angustifolia*. However, I found this feature variable as in *A. protracta* (3–4 teeth), and even more, this variation was observed in a single individual (one side with three teeth the other one with four).

Garrison (1986) mentioned that both species are sympatric, at least, in Lago de Catemaco, Veracruz State, Mexico. I found the two species at Laguna Miradores, Veracruz, which represents the second record of sympatry for both species.

Most of the exuviae of *A. protracta* were found in a vertical position in tall grasses and stems of *Eichhornia crassipes* (Mart.). One exuvia of *A. angustifolia* was collected vertically on a grass stem, another quite horizontal on the muddy shore of a lagoon (Fig. 11); another larva collected in the same lagoon emerged on a cobble and molted horizontally in the laboratory.

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