

**BIOSYSTEMATICS OF THE LARVAE OF THE  
GENUS ARGIA IN MEXICO  
(ZYGOPTERA: COENAGRIONIDAE)**

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Detailed descriptions are provided of larvae of *A. fissa* Sel.\*, *A. fumipennis violacea* Hag., *A. harknessi* Calv.\*, *A. lacrimans* Hag.\*, *A. lugens* Hag., *A. oenea* Hag.\*, *A. pulla* Hag.\*, *A. rhoadsi* Calv.\*, *A. tezpi* Calv.\*, *A. ulmeca* Calv.\*, *A. munda* Calv., *A. plana* Calv., *A. tarascana* Calv. and *A. tonto* Calv. Those asterisked (\*) are described here for the first time. Larvae of all spp. are diagnosed, using a new character for the genus, i.e. the ♂ pharate caudal app. (cerci). Some previously poorly or incompletely described spp. are redescribed. Figs of all taxonomic characters and the ecological data are included.

**INTRODUCTION**

The New World genus *Argia* is one of the largest odonate genera (approx. 150 spp.; cf. DAVIES, 1981), and it has reached a high taxonomic complexity. In spite of its abundance and wide distribution, the larvae are poorly known. Up to now only 20 species (13% of known species) are known in their larval stage: *A. apicalis* Say, *A. moesta* Hagen, *A. tibialis* Rambur, *A. fumipennis violacea* Hagen (NEEDHAM, 1903); *A. lugens* Hagen (NEEDHAM & COCKERELL, 1903; NEEDHAM, 1904); *A. fumipennis atra* Gloyd (NEEDHAM, 1904); *A. emma* Kennedy, *A. vivida* Hagen (KENNEDY, 1915); *A. translata* Hagen (GARMAN, 1927; BROUGHTON, 1928; GEIJSKES, 1946); *A. sedula* Hagen (SEEMAN, 1927); *A. insipida* Hagen (GEIJSKES, 1943); *A. difficilis* Selys, *A. orichalcea* Hagen (GEIJSKES, 1946); *A. sordida* Selys (SANTOS, 1968); *A. concinna* Rambur (DONNELLY, 1970); *A. nahuana* Calvert (PROVONSHA & McCAFERTY, 1973); *A. oçulata* Hagen (LIMONGI, 1983); *A. munda* Calvert, *A. plana* Calvert, *A. tarascana* Calvert and *A. tonto* Calvert (WESTFALL, 1990).

NEEDHAM (1903) briefly described *A. fumipennis violacea*, and NEEDHAM & COCKERELL (1903) and NEEDHAM (1904) described and illustrated *A. lugens*. However, these descriptions were either based on young larvae or were poorly illustrated, making identification impossible.

In Mexico *Argia* has at least 46 species (PAULSON 1982), plus many more undescribed species. Thirteen mexican species (28%) have been described. Here, I describe the larvae of 13 more species and relate these to their congeners.

#### METHODS

Larvae were collected from tropical rain forests, tropical deciduous forests, cloud forests and pine-oak forests, located in several states of the Mexican Republic, including lotic and lentic environments. Specimens were obtained in two ways: (1) collecting newly emerged individuals and their cast skins, and (2) collecting mature larvae and rearing them in small aquaria. In the latter case, larvae were fed *Artemia salina* until their emergence. Teneral adults were kept alive until they were sufficiently hardened for identification, and exuviae and some larvae were preserved in 80% ethanol. I recorded the ecology and emergence times for most species; times were recorded just when the thorax began to split.

Descriptions are from preserved final instar larvae or exuviae. Terminology of the labium is from CORBET (1953); thus, seta means hair-like seta. Drawings were made with the aid of a camera lucida on a stereoscopic microscope.

A total of 13 species and one subspecies were successfully reared or collected with skins at emergence: *A. fissa*, *A. fumipennis violacea*, *A. harknessi*, *A. lacrimans*, *A. lugens*, *A. munda*, *A. oenea*, *A. plana*, *A. pulla*, *A. rhoadsi*, *A. tarascana*, *A. tezpi*, *A. tonto* and *A. ulmea*.

All specimens are deposited in the author's collection.

#### DIAGNOSIS OF ARGIA LARVAE

Generally stout and short, yellow to dark brown; head wider than long, cephalic lobes with stout spiniform setae; antennae 6 or 7-jointed, usually longer than head; labium short without well developed dorsoapical premental setae, but with lateral and basidorsal spiniform setae; ligula slightly arcuate to prominent, its distal border convex and covered with small claviform setae, two small spines near distal border on dorsal side; palpi usually with 1-4 setae (rarely 0 or 5), its external border covered with small spiniform setae, internal border slightly serrated, distally ending in two hooks, the inferior one the largest (Figs 29b, 38b). Thorax robust; prothorax, in dorsal view with posterolateral margins angularly produced and covered with spiniform setae. Legs short, femora pale with dark rings, claws with pulvilliform empodium. Wing cases in full grown larvae usually extending to abdominal segment 4 or 5. Abdomen short, covered with setae, spiniform setae or both; gonapophyses well developed in both sexes, with spiniform, claviform or hairlike setae on their ventral borders. Gills usually laminar, but also triquetral, saccoid or a combination of these, and generally ending in a filamentous tip.

Measurements for the following descriptions are given in Table I.

Table I  
Measurements of *Argia* larvae (mm)

Species	Total length (without gills)		Maximum width of head		Hind femur		Lateral gill		Central gill	
	♂	♀	♂	♀	♂	♀	♂	♀ (including tip)	♂	♀
<i>fissa</i>	12.3-14.5	12.7-15.3	3.6-3.7	3.6-4.0	3.7-4.1	3.7-4.0	6.4-6.6	4.0-7.0	4.8-6.0	5.0-6.0
<i>fvioleacea</i>	11.5	13.4-14.2	3.6	4.0	3.5	3.7-3.9	5.0	5.3-5.5	4.8	5.1
<i>harknessi</i>	12.0-14.5	12.8-14.0	3.5-3.9	3.7-3.9	3.6-3.9	3.7-4.1	4.8	5.0-5.5	3.7	3.5-3.6
<i>lacrimans</i>	21.0-21.9	17.3-17.6	4.2-4.6	4.0-4.5	5.0-6.7	4.5-5.0	5.2-5.5	5.0-6.3	4.0-5.5	-
<i>lugens</i>	14.6-18.7	-	4.8-5.2	-	4.7-5.3	-	5.7-6.2	-	5.1-5.3	-
<i>munda</i>	10.5-14.7	11.7-13.6	3.7-3.9	3.9-4.1	3.2-3.4	3.3-3.8	5.0-5.1	5.0-6.0	4.5-4.8	4.5-5.5
<i>oenea</i>	13.0	12.3	3.7	3.6	3.0	3.2	5.8	6.7	4.5	4.5
<i>plana</i>	14.2	-	3.8	-	3.1	-	3.5	-	3.4	-
<i>pulla</i>	10.1-12.3	12.9	2.9-3.1	2.9	2.9-3.1	2.9	4.8-6.0	4.5	4.6-5.3	4.1
<i>rhoadsi</i>	11.0-12.0	10.6-11.6	3.3	3.3-3.4	3.0-3.6	3.2	5.2-5.4	5.4-5.7	5.0-5.2	4.0-5.2
<i>tarascana</i>	11.8-14.0	12.5-13.6	3.5-3.9	3.5-3.9	3.4-3.8	3.3-3.6	4.9-6.5	4.5-5.5	4.0-5.0	4.4
<i>tezpi</i>	13.1-14.0	12.0-15.0	4.0	3.7-4.0	3.5-3.7	3.5-3.7	4.5-6.6	4.3-6.0	3.9-5.5	4.2-4.8
<i>tono</i>	14.8	14.4-16.6	4.4	4.3-4.5	4.6	4.0-4.8	5.6	5.5-7.4	5.4	4.9-6.1
<i>ulmeca</i>	14.7-17.3	14.3-14.6	4.1-4.2	4.1	4.1-4.2	4.1-4.5	5.5-7.5	4.0-5.1	6.1	4.1

### ARGIA FISSA SELYS

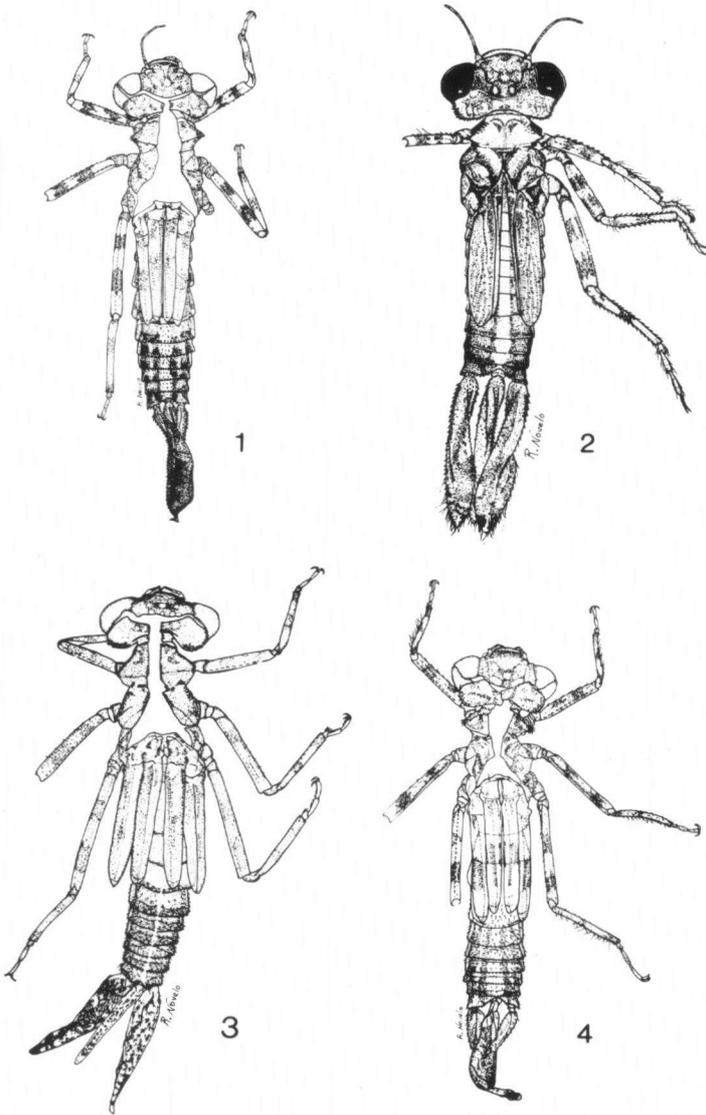
Figures 1, 20, 32, 49, 66, 72, 95

Material -- 4 larvae (2 ♂, 2 ♀), 7 exuviae (3 ♂, 4 ♀) MEXICO: Hidalgo, Molango, Laguna de Atezca (1450 m), 27-VII-86, 2 ♂, 2 ♀; 16-XI-85, 1 ♂ S. Ibáñez leg.; - Morelos, Temilpa Viejo, Rio Yauatepec (1210 m), 14-III-87, 1 ♂, 1 ♀. - Jantetelco (1190 m), 24-II-85, 2 ♀. - Jiutepec, Las Fuentes (1340 m), 13-X-85, 1 ♂; - Puebla, La Unión (580 m), 23-VII-87, 1 ♀. - Unless stated otherwise, all R. Novelo leg.

DESCRIPTION -- Larvae dark brown, body stout and short.

**H e a d** mottled (Fig. 1), wider than long, posterior border widely concave, cephalic lobes bordered with robust spiniform setae; labrum yellowish-brown. Antennae 7-jointed (Fig. 20), longer than head, scape yellow, pedicel with a pseudobasal dark ring, flagellomeres pale brown with distal ends yellow, ratio of lengths of antennomeres: 0.40, 0.75, 1.0, 0.75, 0.45, 0.30, 0.20. Labium yellow-brown to dark brown; hinge extending to anterior margin of mesosternum; prementum with 15-16 lateral and 5-7 basidorsal spiniform setae (Fig. 32); ligula moderately prominent; palp with 3 or 3 + 1 setae, other features as stated for the genus.

**T h o r a x:** Anterodorsal pronotum with scattered spiniform setae. Synthorax robust, anterior and posterior wing sheaths extending to basal 0.30 and 0.60 of abdominal segment 5 respectively, although variable due to postmortem preservation, with a color pattern of alternating pale and dark transversal bands (Fig. 1). Legs yellow, with dark brown rings on femora and tibiae; two rows of spiniform setae on dorsal and ventral surfaces of femora diminishing in number and robustness on meso- and metafemora; anterior and posterior surfaces of profemora and anterior surface of mesofemora with spiniform setae; protibiae with long delicate setae on external surface and spiniform on internal one, both kinds of setae on both surfaces of other tibiae, numerous at apices; tarsi yellow, with long delicate



Figs 1-4. Dorsal aspect of *Argia* larvae: (1) *A. fissa*, ♂ exuviae; - (2) *A. fumipennis violacea*, ultimate instar, ♂; - (3) *A. harknessi*, ♂ exuviae; - (4) *A. lacrimans*, ♀ exuviae.

setae on dorsum and stout setae on venter; claws yellow.

A b d o m e n brown, with a pale middorsal stripe throughout widening gradually from segment 6 to rear; tergites 1-4 with small setae, 5-10 with spiniform

setae mainly on lateral and posterior margins, increasing in number, size and robustness posteriorly, with long setae on pale middorsal stripe. Sternites brown, 1-7 with small setae, 8-10 with spiniform setae, stout on posterior margin of 10. Male gonapophyses pyramidal (Fig. 49), dark, short, extending posteriorly to basal 0.25 of sternite 10, tips acute and parallel; ventral border with 5-6 spiniform setae on basal 0.50 and 2-3 long setae at base of apical 0.50. Female gonapophyses exceeding posterior margin of sternite 10 for 0.50 the length of 10; in ventral view lateral ones (Fig. 66a) with long, acute and divergent tips; ventral border with 13-15 spiniform setae on basal 0.75 and two long setae at base of apical 0.25; in lateral view as Figure 66b. Central gonapophyses smooth, slightly shorter than lateral ones and concolours. Gills laminar (Fig. 72), narrow at base, ending in a filamentous tip; color pattern mottled; laterals (Fig. 72b) three times as long as wide, with an external lateral carina close and parallel to ventral border, extending over basal 0.60 of gill and covered with spiniform setae; dorsal and ventral borders with spiniform setae on basal 0.17 and 0.66 respectively, remainder of borders with delicate white setae. Central gill (Fig. 72a) twice as long as wide, without lateral carinae; dorsal and ventral borders with spiniform setae on basal 0.50 and 0.18 respectively, remainder of borders as for lateral lamellae. Male cerci enlarged, bluntly pointed (Fig. 95 a-e), slightly concave ventrally.

Remark. - Some individuals have a poorly defined dark ring on antennal pedicel.

ECOLOGY. - Larvae inhabit lagoons, streams and rivers, where they cling to roots, submerged or floating vegetation, or decayed leaves and twigs accumulated at backwaters of streams and rivers. Specimens collected at Hidalgo were found with *A. rhoadsi*. Adults are year-round at least in Morelos (GARCIA, 1987) and Hidalgo, and emergence probably occurs throughout the year. Emergence in the laboratory occurred between 11:41 and 13:08 h.

DISCUSSION. - *A. fissa* belongs to the group with ligula moderately prominent, they show close resemblance to those of *A. tarascana* described by WESTFALL (1990) and reared by myself (cf. below). Both are similar in the mottled general appearance of the body, 3 setae on palpus and shape of male and female gonapophyses. They differ in size and in shape and color pattern of gills, as well as in shape of male cerci. In this last feature *A. fissa* resembles *A. rhoadsi*.

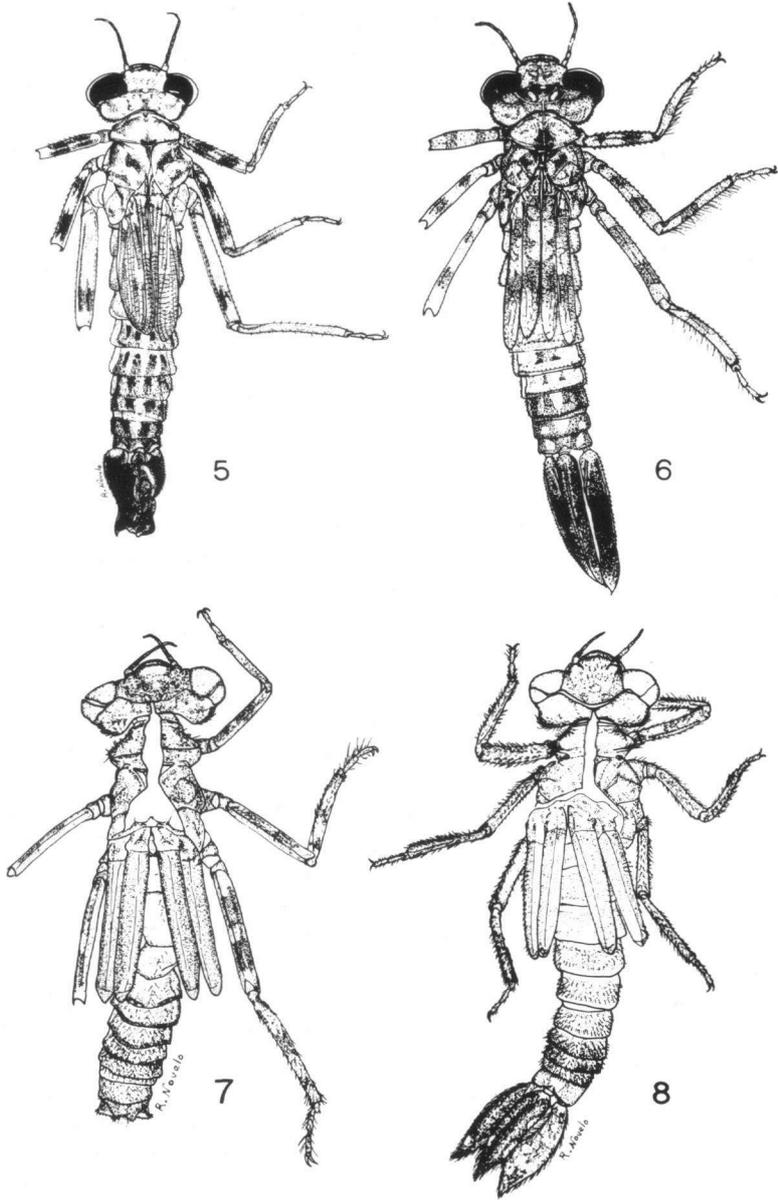
#### ARGIA FUMIPENNIS VIOLACEA HAGEN

Figures 2, 19, 38, 56, 69, 77, 87

Material. - 13 larvae (4 ♂, 7 ♀), 2 exuviae (♀) MEXICO: Durango, La Michilfa, arroyo Corralitos, 23-VIII-87, 1 ♂; 9-XII-87, 1 ♂; - arroyo El Temazcal, 10/12-XII-87, 2 ♂, 10 ♀. - All R. Novelo & E. González leg.

DESCRIPTION. - Larvae brown, body stout and short (Fig. 2).

Head as in *A. fissa*; a pale triangular spot on each side of median ocellus. Antennae 7-jointed (Fig. 19), longer than head, pedicel dark but pale at base,



Figs 5-8. Dorsal aspect of *Argia* larvae: (5) *A. lugens*, ultimate instar, ♂; - (6) *A. munda*, ultimate instar, ♂; - (7) *A. oenea*, ♀ exuviae (gills detached); - (8) *A. plana*, ♂ exuviae.

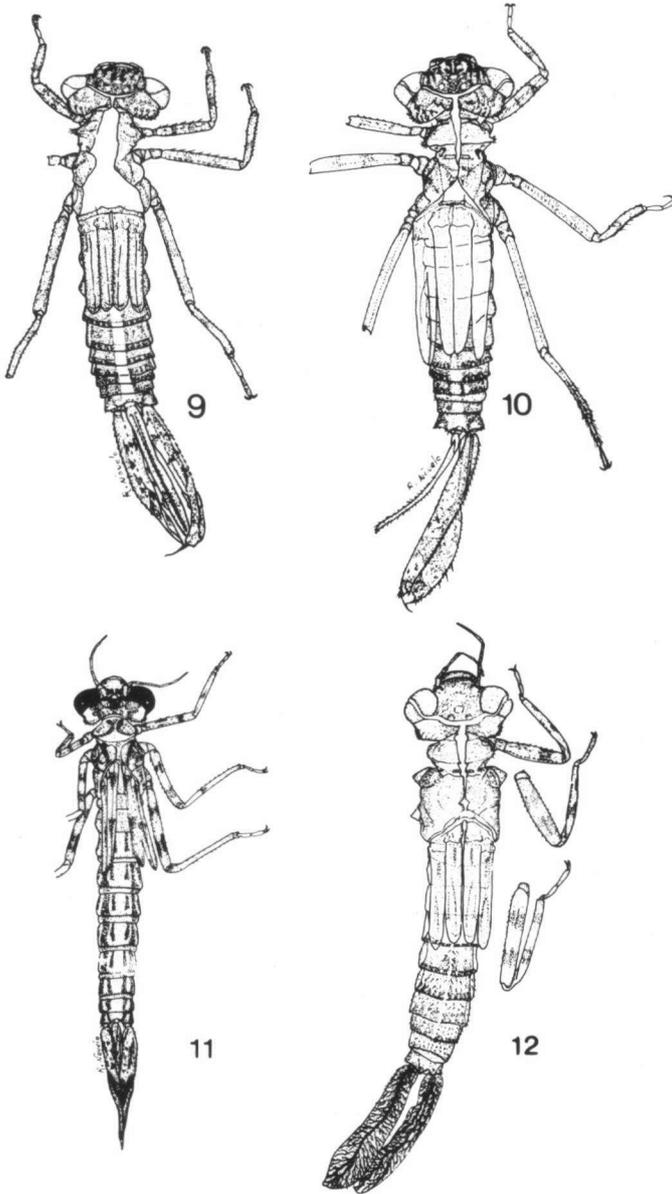
other antennomeres yellow, ratio of length of antennomeres: 0.50, 0.75, 1.0, 0.98, 0.65, 0.40, 0.20. Labium with hinge extending posteriorly to 0.50 of mesosternum; prementum longer than wide (Fig. 38), with 11 lateral and 7 basidorsal spiniform setae; ligula barely prominent; palpus with 3 long setae (Fig. 38b), other features as in *A. fissa*.

**Thorax:** Pronotum as in *A. fissa*: Synthorax stout, wing sheaths extending to abdominal segment 6. Legs yellow, otherwise similar to *A. fissa*; tibiae densely covered with intercalate spiniform setae and long setae; tarsi yellow, spiniform setae on under side and delicate setae on dorsum; claws yellow.

**Abdomen** - brown, with a broad middorsal pale stripe narrowing suddenly on 10 (Fig. 2), a dark spot on each side of this stripe on 4-9; sides and dorsum of 4-10 and ventroposterior margin of 7-10 with spiniform setae increasing in number, size, and thickness posteriorly; posterior borders of each tergite with stout spiniform setae; middle part of dorsum of 1-4 with tufts of long white setae. Male gonapophyses pyramidal (Fig. 56), reaching posteriorly to 0.70 length of sternite 10, tips acute and divergent; ventral border with 8-9 stout spiniform setae. Female gonapophyses (Fig. 69) just surpassing sternite 10; in ventral view, laterals (Fig. 69a) with tips acute and slightly divergent; ventral border with 12-15 stout spiniform setae and 2-3 long setae at base of apical 0.33 (Fig. 69b); central gonapophyses smooth, shorter than lateral ones. Gills laminar, ovate, brown without a definite pattern, twice as long as wide, narrowed at base, apex widely rounded not attenuated at tip; dorsal and ventral borders with intermingled spiniform and long hair-like setae, except at apex; laterals (Fig. 77a) with a lateral carina on external surface extending over 0.75 the total length of gill, carina covered with spiniform setae. Central gill (Fig. 77b) with one carina each side extending over 0.55 length of gill and similarly covered with small spiniform setae. Male cerci enlarged, bluntly pointed (Fig. 87a, b, d); in posterior view notably wider than high, with a small concavity on venter, and dorsal margin sigmoid (Fig. 87c).

**ECOLOGY.** - Larvae are typical stream-dwellers, preferring sites where backwaters are formed, clinging under rocks, among gravel and submerged grasses. Emergence occurred between 10:09 - 1:53 h in the laboratory.

**DISCUSSION.** - *A. f. violacea* belongs to the group with a slightly prominent ligula; it differs from the description of *A. f. atra* Gloyd (NEEDHAM, 1904) from Florida in having 3 long well developed setae on palpus and 7-jointed antenna, while Needham cites 2 + 1 setae and 6-jointed antennae; they agree in all other characters. *A. f. violacea* shares the following characters (other species in parentheses): antennal pedicel darker than remaining antennomeres (*fissa*, *plana*, *rhoadsi*); three palpal setae (*apicalis*, *rhoadsi*, *tarascana*); broad middorsal pale stripe on abdomen (*emma*, *fissa*, *lacrimans*, *nahuana*, *pulla*, *rhoadsi*); shape of male gonapophyses (*lugens*, *munda*, *tonto*); shape of gills (*munda*, *nahuana*); shape of male cerci (*pulla*).



Figs 9-12. Dorsal aspect of *Argia* larvae: (9) *A. pulla*, ♂ exuviae; - (10) *A. rhoadsi*, ♂ exuviae; - (11) *A. tarascana*, ultimate instar, ♀; - (12) *A. tezpi*, ♂ exuviae.

*ARGIA HARKNESSI* CALVERT

Figures 3, 18, 37, 45, 58, 73, 96

Material -- 22 larvae (12 ♂, 10 ♀), 2 exuviae (♂), MEXICO: Morelos, Vicente Aranda, Rio Amacuzac (800 m), 23-I-82, 3 ♂, 2 ♀, R. Arce leg.; 11-XII-82, 4 ♂, 2 ♀, G. Rodríguez leg.; 12-II-83, 5 ♂, 5 ♀, G. Cardoso leg.; - Cuautla, Las Tazas (1320 m); 19-II-86, 1 ♂, R. Novelo leg.; - Tehuixtla, Rio Amacuzac (750 m), 19-IV-86, 1 ♂, 1 ♀, R. Novelo leg.

DESCRIPTION. - Larvae pale brown, body stout and short (Fig. 3).

**H e a d** - as in *A. fissa*; labrum red-brown. Antennae 7-jointed (Fig. 18), slightly longer than head, scape yellow, pedicel slightly darker than brown flagellomeres; ratio of lengths of antennomeres: 0.45, 0.60, 1.0, 0.75, 0.45, 0.20, 0.10. Labium with hinge extending to posterior margin of prosternum; prementum longer than wide (Fig. 37), with 17-23 lateral and 7-10 basidorsal spiniform setae; ligula prominent; palp with one short seta, external border dark, covered with spiniform and claviform setae, internal and apical borders as in other species.

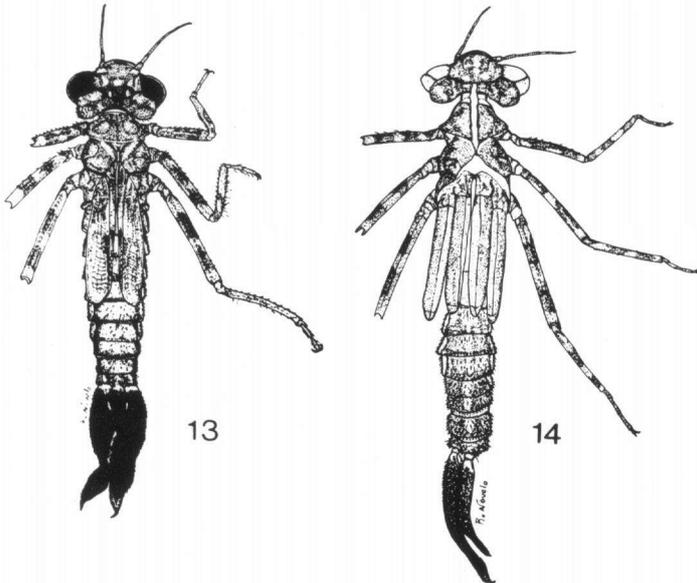
**T h o r a x**. - Anterodorsal portion of pronotum with setae and spiniform setae. Synthorax robust, anterior wing sheaths extending to posterior margin of abdominal segment 4, posterior ones slightly longer, yellow-brown with diffuse pale spots on extreme base and nodus. Legs yellow, femora flattened; other features as in *A. fissa*.

**A b d o m e n**. - Yellow on 1-4, 5-10 red-brown, a prominent subquadrangular dark spot on each side of pale midline on 2-5, less conspicuous on 6-8 in mature individuals; pale midline widening notably on 8-10; lateroventral portions of 1-6 with dark spots comprising total length of 1-2 and apical half of 3-6. Tergites 1-4 with minute setae, 5-10 with spiniform setae increasing in number, size and thickness posteriorly, mainly at sides and on posterior margins; middle part of tergites 2-10 with tufts of long setae. Sternites yellow, 2-7 with a dark subtriangular spot on each side of midline; posterior margin of 7 and sternites 8-10 with spiniform setae; middle part of 8 with abundant claviform setae. Male gonapophyses spatulate (Fig. 45), extending posteriorly to basal 0.75 of sternite 10, tips rounded and divergent; ventral border with 22-24 stout claviform setae. Female gonapophyses exceeding posterior margin of 10 by 0.25 length of 10; laterals, in ventral view (Fig. 58a), with apices blunt, ventral border with 26-29 stout claviform setae on basal 0.80; in lateral view as in Figure 58b; central ones smooth and slightly longer than lateral ones. Gills mainly laminar, but a little inflated at extreme base (Fig. 73); lateral ones little more than twice as long as wide, with a small lip at apex (Fig. 73b); coloration obscure on basal 0.75, white on apical 0.25; dorsal border with a few spiniform setae on basal 0.12; apical 0.33 of both borders with delicate white setae, remainder of borders smooth. Central one less than twice as long as wide, coloration as in Figure 73a, otherwise as in lateral ones. Male cerci short, globulous (Fig. 96c), roundly pointed (Fig. 96a).

**Remark.** - Great variation exists in gill pigmentation, primarily in young instars.

**ECOLOGY.** - Larvae are typical of open stream habitats; individuals were taken clinging among the phanerogam *Ceratophyllum demersum* L., which is characteristic of rapid water flow. Adults are year-round in Morelos (GARCIA, 1987) and emergence probably occurs throughout the year. Emergence in laboratory was observed at 12:17 and 12:41 h.

**DISCUSSION.** - *A. harknessi* belongs to the group with a very prominent ligula and one palpal seta. They are similar to GEIJSKES' (1943) description of *A. insipida*, being similar in general appearance, proportion of antennomeres, shape and coloration of gills and in male and female gonapophyses, but males are unique in having spatulate gonapophyses. These species differ only by the coloration of the antennomeres and the greater length of the male gonapophyses of *A. insipida*. *A. harknessi* resembles *A. oenea* in shape of male cerci.



Figs 13-14. Dorsal aspect of *Argia* larvae: (13) *A. tonto*, ultimate instar, ♂; - (14) *A. ulmeca*, ♀ exuvia.

### ARGIA LACRIMANS HAGEN

Figures 4, 24, 39, 52, 61, 74, 97

**Material.** - 7 larvae (4 ♂, 3 ♀), 2 exuviae (♂, ♀). MEXICO: Hidalgo, Cacala (2000 m), 15-XI-85, 2 ♂, 1 ♀; - Tepeoco (1750 m), 29-VII/1-VIII-86, 2 ♂, 2 ♀; - Morelos, Tepoztlán (1705 m), 8-XI-86, 1 ♀; II-87, 1 ♂. - All R. Novelo leg.

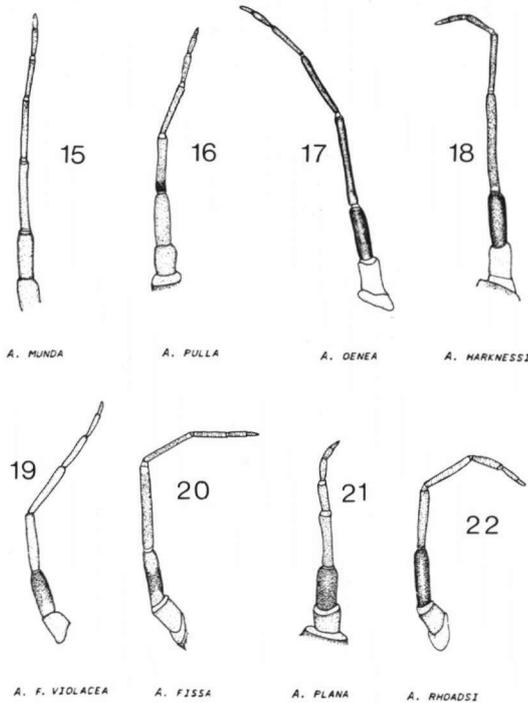
**DESCRIPTION.** - Larvae brown, body stout (Fig. 4).

**H e a d** - as in *A. fissa*; labrum yellow-brown. Antennae 7-jointed (Fig. 24), longer than head, yellow-brown, pedicel slightly darker than remaining antennomeres, ratio of lengths of antennomeres: 0.50, 0.65, 1.0, 0.70, 0.40, 0.20, 0.10. Labium dark, hinge extending to anterior margin of mesosternum; prementum longer than wide (Fig. 39), with 15-17 lateral and 7-8 basidorsal spiniform setae; ligula barely prominent; palp yellow, with two long setae, its external border with spiniform setae, basal 4-5 larger and stouter than remaining ones, internal and apical borders as in preceding species.

**T h o r a x** - Pronotum as in *A. fissa*. Synthorax dark, a pale spot on meso- and metepimera, densely covered with setae; anterior wing sheaths almost extending

to posterior margin of abdominal segment 4, posterior ones slightly exceeding it, with a color pattern of alternating pale and dark transversal bands. Legs yellow-brown, with dark brown rings on femora and tibiae; rows of spiniform setae on femora as in *A. fissa*; anterior and posterior surfaces of pro- and mesofemora with spiniform setae; tibiae with setae and spiniform setae on external surface, only spiniform setae on internal one, more abundant and robust at apices; tarsi yellow-brown, with long delicate setae on dorsum and stout setae on underside; claws yellow-brown.

**A b d o m e n** - Tergites brown, with a broad pale middorsal stripe with alternating dark and pale stripes

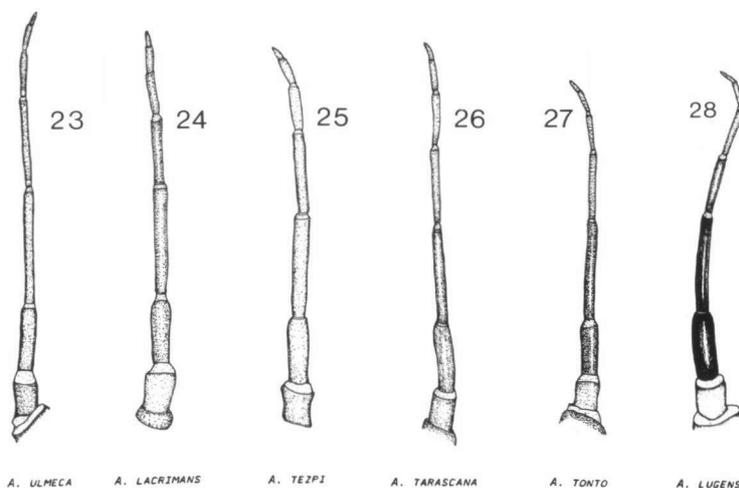


Figs 15-22. Antennae of *Argia* larvae: Figs 15, 17, 19, 20, 22, lateral view; - Figs 16, 18, 21, dorsal view.

laterally (Fig. 4); tergites 1-5 with abundant stout setae which become spiniform on posterior and lateral margins of 5 and on 6-10, diminishing in number and length posteriorly, but increasing in robustness. Sternites yellow, 2-7 with a mesial basal rectangular dark spot; 1-6 with small delicate setae, spiniform on 7-10, abundant on 8-10. Male gonapophyses pyramidal, extending posteriorly over 0.85 length of sternite 10; in ventral view (Fig. 52a) with apices long, sharp and

divergent; its ventral border with 11-13 spiniform setae on basal 0.66 and 2 setae at base of apical 0.33 (Fig. 52b). Female gonapophyses exceeding 0.30 length of 10; lateral ones in ventral view (Fig. 61a) with apices long, sharp and divergent; ventral border with 15-16 spiniform setae on basal 0.70 and 1-2 long setae at base of apical 0.30; in lateral view as in Figure 61b; central ones dark, smooth and slightly shorter than lateral ones. Gills laminar, ovate, narrowing at both ends, dark, with a small blunt tip; lateral ones (Fig. 74a) with minute setae on dorsal border increasing in size and number at apical 0.25, ventral border with spiniform setae on basal 0.70 of inflated portion of external side. Dorsal and ventral borders of central gill (Fig. 74b) with spiniform setae on basal 0.35 and 0.25 respectively, remainder with delicate setae; a longitudinal row of spiniform setae on basal 0.50 of inflated portion at both sides. Male cerci enlarged, bluntly pointed (Fig. 97a); in ventral view (Fig. 97d) with external sides longer than inner ones; apices conical.

**R e m a r k .** - Some individuals with regenerated legs lacked the obscure ringed pattern on femora and tibiae as well as the arrangement in rows of spiniform setae.



Figs 23-28. Antennae of *Argia* larvae: Figs 23, 28, lateral view; - Figs 24, 25, dorsal view; - Figs 26, 27, ventral view.

**ECOLOGY.** - Larvae of this species occur in small rocky streams where water flow is rapid (Tepeoco) and also where pools are formed (Tepoztlán); they were usually found among roots, gravel and rocks. Adults fly from May to November at Morelos (GARCIA, 1987) and from March to December at Hidalgo, thus emergence probably extends over several months. Emergence occurred at 11:08 and 12:27 h on April 18, 1987 in the laboratory.

DISCUSSION. - *A. lacrimans* belongs to the group with slightly prominent ligula and appears to be related to *A. tonto* described by WESTFALL (1990) and reared by myself (cf. below). Both share the following characters: coloration and proportion of antennomeres, labial palpi with 2 setae, male gonapophyses sharp and divergent and gills saccoid-laminar with dark coloration. They differ in the lesser development of the ligula of *lacrimans* and the smaller body size of *tonto*; the male cerci of *lacrimans* are more enlarged with conical apices.

### ARGIA LUGENS HAGEN

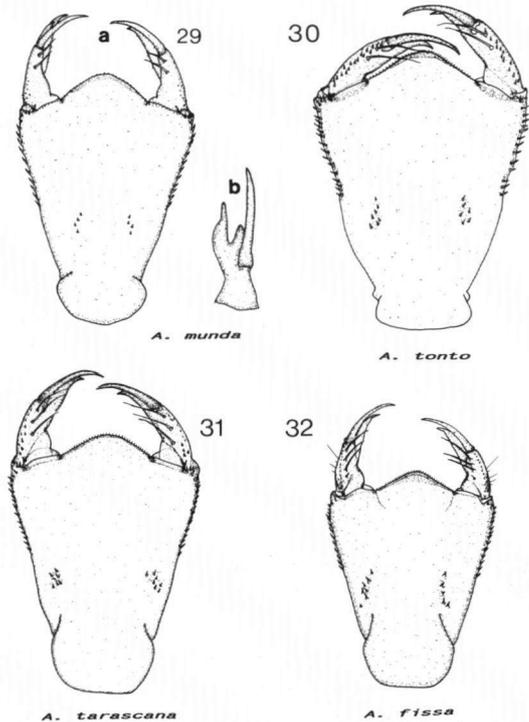
Figures 5, 28, 33, 50, 65, 79, 84

Material. - 21 larvae (13 ♂, 8 ♀). MEXICO: Durango, La Michilia, arroyo Corralitos, 16-IV-87, 3 ♂; - arroyo El Tamazcal, 15-IV-87, 1 ♂; 10-XII-87, 9 ♂, 8 ♀. - All R. Novelo & E. González leg.

DESCRIPTION. - Larvae brown, body stout and enlarged (Fig. 5).

**H e a d** - as in *A. fissa*. Antennae 7-jointed (Fig. 28), longer than head, scape yellow, other antennomeres brown, light brown on 6-7, ratio of lengths of antennomeres: 0.35, 0.55, 1.0, 0.60, 0.45, 0.25, 0.15. Labium with hinge extending to 0.50 of mesosternum; prementum longer than wide (Fig. 33), with 19-21 lateral and 18-20 basidorsal spiniform setae; ligula prominent; palp with one long seta, its external border with abundant spiniform setae, other features as in preceding species.

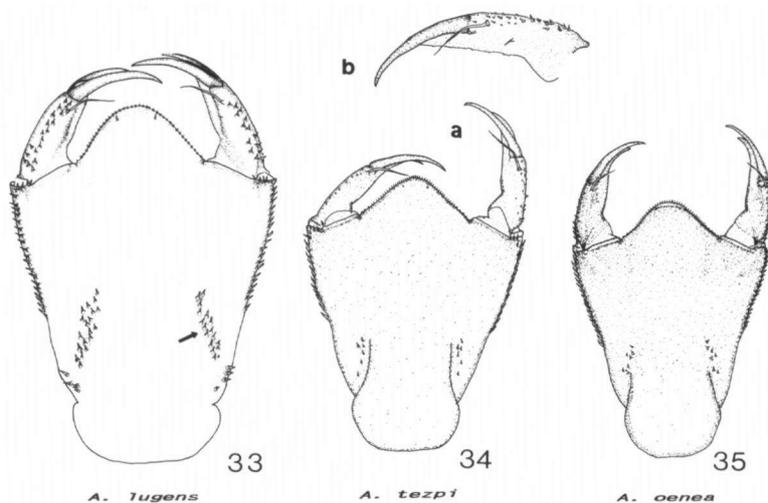
**T h o r a x** - Anterodorsal corners of pronotum dark, with spiniform setae. Synthorax stout, color pattern as in Figure 5; wing sheaths extending to basal 0.50 of abdominal segment 5, light brown with diffuse white spots at base and nodus.



Figs 29-32. Labia of *Argia* larvae, dorsal view: (a) prementum; - (b) detail of left palpus, external view.

Legs yellow, two broad dark rings on femora; tibiae yellow or red-brown, without dark rings at least on pro- and mesotibiae; tarsi and claws yellow; arrangement of setae and spiniform setae as in *A. fissa*.

**A b d o m e n** - light-brown, tergites 2-10 each with a narrow pale middorsal stripe and two dark lateral spots; tergites 1-5 with abundant setae which become spiniform at sides of 3-8 and on dorsum of 6-10, increasing in number and thickness posteriorly, mainly on posterior and lateral margins; with tufts of long setae along middorsal line. Sternites 7-10 with spiniform setae, more abundant on 8 and 10. Male gonapophyses pyramidal, gradually tapering posteriorly; in ventral view (Fig. 50a) with long, divergent sharp tips and exceeding posterior margin of 10 for 0.25 length of 10; ventral border with two rows of spiniform setae over basal 0.65, external side with a short row of stout spiniform setae; 6-7 long setae at base of apical 0.25; in lateral view as in Figure 50b. Female



Figs 33-35. Labia of *Argia* larvae, dorsal view: (a) prementum; - (b) detail of right palpus, internal view. - [Arrow indicates the basidorsal spiniform setae]

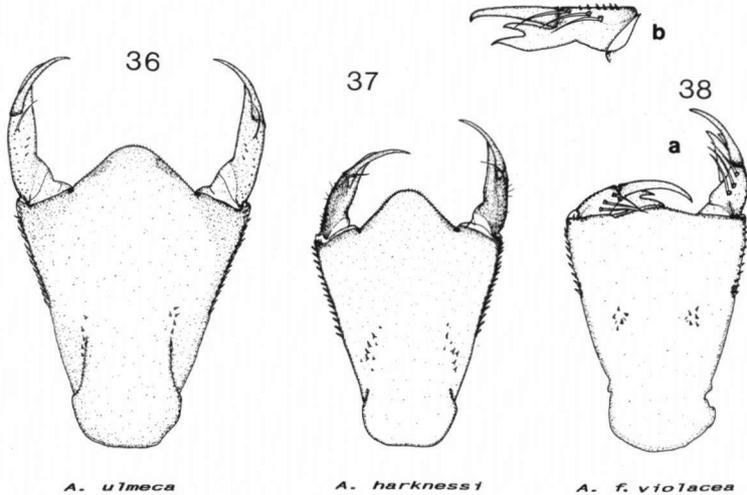
gonapophyses exceeding posterior margin of 10 for 0.35 length of 10; laterals, in ventral view (Fig. 65a) ending in long, parallel, sharp tips; ventral border with two rows of spiniform setae over basal 0.65 and 5-6 spiniform setae on external side; 3-4 long setae at base of apical 0.35; in lateral view as in Figure 65b. Central ones smooth, shorter than laterals. Gills laminar, oblong, dark brown but pale at both ends, with a very small apical tip (Fig. 79); dorsal and ventral borders with spiniform setae only at basal extreme and minute white setae on remainder, increasing in length towards apex; lateral gills almost 3 times as long as wide

(Fig. 79a), central one twice as long as wide (Fig. 79b). Male cerci short, roundly pointed (Fig. 84a), in posterior view with inferior margin almost straight (Fig. 84c); concave ventrally (Figure 84d).

**Remark.** - Some young individuals exhibit gray gills with two transverse dark bands, one about at the middle and the other at 0.75 of the total length.

**ECOLOGY.** - As in *A. f. violacea*. I did not see emergence in the laboratory.

**DISCUSSION.** - *A. lugens* belongs to the group with a prominent ligula and one palpal seta. There are no other described congeners which resemble it. However, some features are shared with the following species: antennal scape pale (*harknessi*, *plana*, *tezpi*, *vivida*); shape of male and female gonapophyses (*f. violacea*, *munda*, *tonto*). A feature unique to *A. lugens* is the large number of basidorsal spiniform setae of prementum (Fig. 33, arrow). The male cerci of *lugens* resemble those of *tonto*.



Figs 36-38. Labia of *Argia* larvae, dorsal view: (a) prementum; - (b) detail of right palpus, internal view.

### ARGIA OENEA HAGEN *in* SELYS

Figures 7, 17, 35, 43, 57, 81, 91

**Material.** - 2 exuviae (♂, ♀). MEXICO: Morelos, Tetlana (1200 m), 22-II-85, 1 ♀; - Palo Bolero (1080 m), 23-II-85, 1 ♂. - Both R. Novelo leg.

**DESCRIPTION.** - Exuviae brown, body slender and short (Fig. 7).

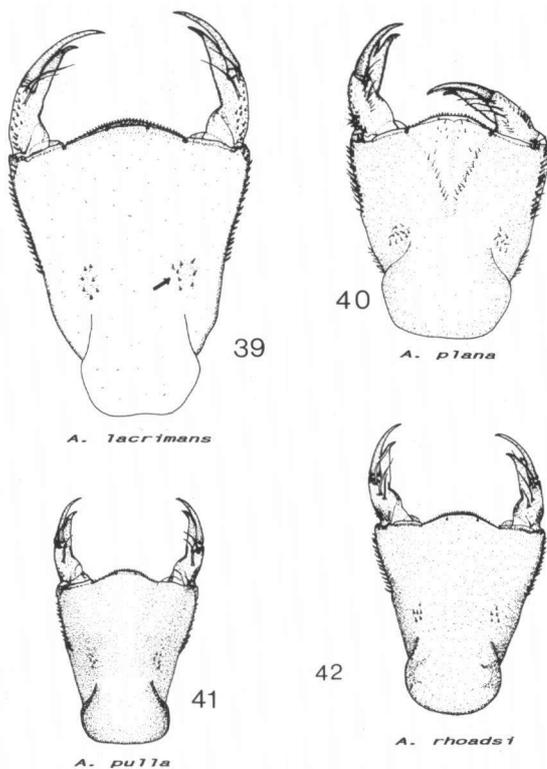
**Head** - as in *A. fissa*; labrum red-brown. Antennae 7-jointed (Fig. 17), scarcely longer than head, basal three antennomeres dark brown, remaining ones yellow-

brown, ratio of lengths of antennomeres: 0.45, 0.60, 1.0, 0.75, 0.50, 0.25, 0.15. Labium dark, hinge scarcely extending to posterior margin of prosternum; prementum longer than wide (Fig. 35), with 17-18 lateral and 5-7 basidorsal spiniform setae; ligula prominent; palp dark brown, with one long seta, its external border with spiniform setae on basal half, internal and apical borders as in preceding species.

**T h o r a x** - Pronotum as in *A. fissa*. Synthorax yellow-brown without any marks; anterior wing cases extending well over basal 0.50 of abdominal segment 4, posterior ones extending to posterior margin. Legs yellow-brown; other features as in *A. fissa*.

**A b d o m e n** - Tergites 1-4 yellow with scattered setae, 5-10 yellow brown with abundant setae which increase in number and size posteriorly, becoming spiniform on posterior margin of 6, and on dorsum, lateral and posterior margins of 7-10; tufts of long setae on middorsal line of 1-10. Sternites yellow-brown, with claviform setae on posterior margin of 7 (except at the middle) and on all the surface of 8; stout spiniform setae on 9-10,

mainly on posterior margin. Male gonapophyses pyramidal, extending posteriorly over basal 0.50 of sternite 10; in ventral view (Fig. 43a) with apices short, blunt and parallel, ventral border with 26 claviform setae throughout except at tip, with or without long setae at base of apical 0.25 (Fig. 43b). Female gonapophyses exceeding sternite 10 for 0.35 the length of 10; lateral ones sigmoidal in ventral view (Fig. 57a), apices blunt and convergent; ventral border with 32-34 claviform setae on basal 0.80 and a short seta at base of apical 0.20; in lateral view as in Figure 57b; central ones dark, smooth and slightly longer than lateral ones. Gills of combined type, saccoid-laminar, grey with pale spots, without a definite pattern,



Figs 39-42. Labia of *Argia* larvae, dorsal view. - [Arrow indicates the basidorsal spiniform setae]

their maximum width at middle; laterals (Fig. 81a) with a long tip comprising 0.38 total length of gill; dorsal and ventral borders with spiniform setae on basal 0.09, then small setae which suddenly increase in number and size at the middle of the gill; spiniform setae on basal 0.18 of inflated portion on external surface, remainder of inflation with white delicate setae. Central gill (Fig. 81b) with tip shorter than in laterals, its dorsal border with spiniform setae only at extreme base, remainder with setae increasing in number and size suddenly at apical 0.45; ventral border with scarce setae on basal 0.60, increasing suddenly in number and size at apical 0.40; remainder of gills as in laterals. Male cerci subspherical; in lateral view roundly pointed (Fig. 91a); slightly concave ventrally (Fig. 91c).

ECOLOGY. - *A. oenea* is a typical stream-dweller, inhabiting zones where the water flow is rapid; the two last instar specimens collected were found among gravel. Adults are year-round at Morelos (GARCIA, 1987), and probably emerge throughout the year. Emergence in the laboratory occurred at 12:52 and 13:10 h.

DISCUSSION. - *A. oenea* is characterized by a prominent ligula with one palpal seta. The specimens are in the following characters similar to *A. "difficilis"* as described by GEIJSKES (1946): general coloration, ratio of lengths of antennomeres, shape of gills, size and shape of gonapophyses and claviform setae on gonapophyses. However, GEIJSKES (1946) described the larvae of *A. "difficilis"* and *A. "orichalcea"* by supposition. I have studied reared material of *A. oenea* and, because the adults of *oenea* and *orichalcea* are similar morphologically, I believe that Geijskes erroneously interchanged the larval descriptions in his 1946 paper. Likewise, the *Argia "difficilis"* of CALVERT (1908) is morphologically related to *A. oculata* whose larva was described by LIMONGI (1983). The published descriptions of *A. oculata* by Limongi and *A. "orichalcea"* by GEIJSKES (1946) are strikingly similar and, I believe, reinforce my opinion that Geijskes interchanged the descriptions of *A. "difficilis"* and *A. "orichalcea"*.

The larvae of *A. concinna* (DONNELLY, 1970) greatly resemble those of *oenea* and *orichalcea*, mainly by features such as general aspect, antennae, labium and gills.

### ARGIA PULLA HAGEN in SELYS

Figures 9, 16, 41, 47, 67, 70, 89

Material. - 22 larvae (15 ♂, 7 ♀), 6 exuviae (2 ♂, 4 ♀). MEXICO: Morelos, Vicente Aranda, Río Amacuzac (800 m), 7-V-83, 11 ♂, 7 ♀, S. Ibáñez leg.; El Estudiante, Río Amacuzac (870 m), 15-V-85, 3 ♂, L. Vázquez leg.; Quebrantadero (1035 m), 7-XI-86, 2 ♂, R. Novelo leg.; Las Estacas (980 m), 1 ♂, 4 ♀, R. Novelo leg.

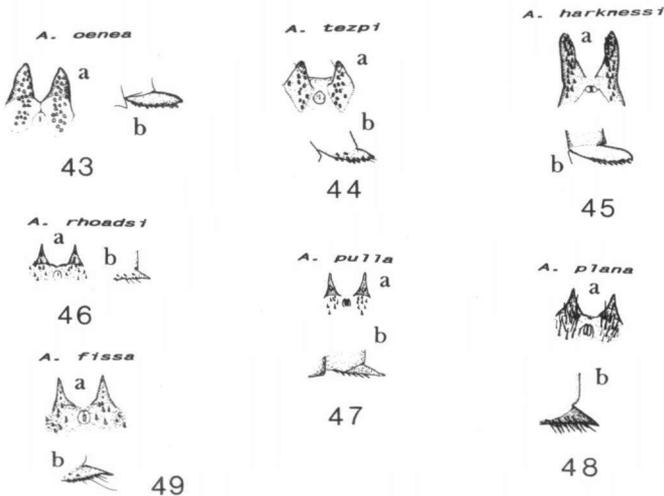
DESCRIPTION. - Larvae yellow-brown, body stout and short (Fig. 9).

Head - as in preceding species. Antennae 7-jointed (Fig. 16), longer than head; scape and pedicel yellow, flagellum yellow brown, a dark basal ring on first flagellomere, ratio of lengths of antennomeres: 0.55, 0.90, 1.0, 0.90, 0.55, 0.30, 0.15. Labium yellow, hinge extending to anterior margin of mesosternum;

prementum longer than wide (Fig. 41), with 11-13 lateral and 4-5 basidorsal spiniform setae; ligula barely prominent; two palpal setae, external border of palp with small spiniform setae mainly at base, internal and apical borders as in other species.

**Thorax** - Pronotum and synthorax as in *A. fissa*; anterior wing sheaths extending backward almost over posterior margin of abdominal segment 4, posterior ones exceeding it. Legs yellow, with diffuse dark rings on femora and tibiae, almost imperceptible on hind legs; setae on femora as in *A. fissa*; tibiae with long, delicate setae and short spiniform ones on external surface, only long spiniform setae on internal surface; tarsi and claws as in *A. f. violacea*.

**Abdomen** - yellow-brown, a middorsal longitudinal pale stripe of the same width throughout; posterior margin of tergites 3-8 with 4 small, oval, pale spots to each side of middorsal pale stripe. Tergites little pubescent, only small spiniform setae on 4-10, mainly at sides and posterior margins, increasing in length, number and robustness posteriorly. Sternites 8-10 with small spiniform setae, very stout on posterior margin of 10. Male gonapophyses conic, small, in ventral view (Fig. 47a) with apices sharp and divergent, extending posteriorly over distal margin of sternite 9, 8-10 spiniform setae on its ventral border and one long seta at base of apical 0.50 (Fig. 47b). Female gonapophyses slightly exceeding posterior margin of 10; lateral ones in ventral view (Fig. 67a) with long, sharp and slightly divergent tips, ventral borders with 15-16 spiniform setae on basal 0.60 and one or two long setae at base of apical 0.40; in lateral view as in Figure 67b; central ones smooth and shorter than lateral ones. Gills of combined type, triquetral at basal 0.65, laminar beyond, narrowed at base; yellow with irregular brown spots,



Figs 43-49. Male gonapophyses: (a) ventral view; - (b) left lateral view.

without a definite pattern; lateral ones (Fig. 70b) with their maximum width at 0.62 length, ending in a long filamentous tip; dorsal and ventral borders covered with spiniform setae on basal 0.77 and 0.85 respectively, and long setae on apical 0.40 in both borders; a lateral carina on each side extending over basal 0.66 and covered with spiniform setae. Central one similar to laterals, but a little broader at base (Fig. 70a). Male cerci enlarged, in lateral view bluntly pointed, slanting ventrally (Fig. 89a); in ventral view with inner sides shorter than lateral ones and with the apices conic (Fig. 89d).

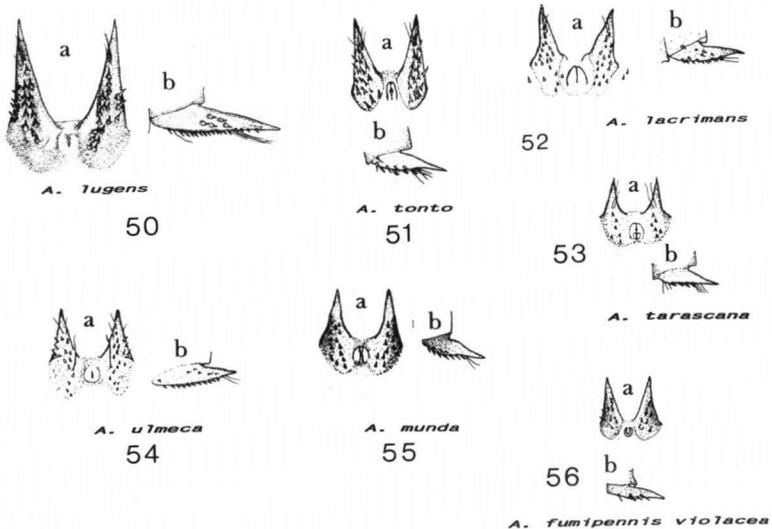
ECOLOGY. - *A. pulla* inhabits rivers, streams and canals where larvae cling to submerged vegetation, roots and among decayed material on the bottom, but always in zones where water flow is slow. They frequently use twigs, plants and rocks to emerge. Adults are abundant year-round in Morelos (GARCIA, 1987), and emergence probably occurs throughout the year. Emergence in the field was observed around 10:30 and 12:45 h on sunny days and at exposed sites.

DISCUSSION. - Larvae of *A. pulla* show close resemblance to those of *A. rhoadsi*. Both species share the following features: small body size, similar shape and pubescence and coloration of gonapophyses and gills. However, they differ in number of palpal setae: 2 in *pulla* and 3 in *rhoadsi*, and in shape of male cerci.

### ARGIA RHOADSI CALVERT

Figures 10, 22, 42, 46, 68, 71, 93

Material. - 8 exuviae (5 ♂, 3 ♀). MEXICO: Hidalgo, Molango, Laguna de Atezca (1450 m), 16-XI-85, 3 ♂, 3 ♀, S. Ibáñez & R. Novelo leg.; Puebla, La Unión (580 m), 23-VII-87, 2 ♂, R. Novelo leg. (4 specimens collected as ultimate instar larvae).



Figs 50-56. Male gonapophyses: (a) ventral view; - (b) left lateral view.

DESCRIPTION. - Exuviae brown, body stout and short (Fig. 10).

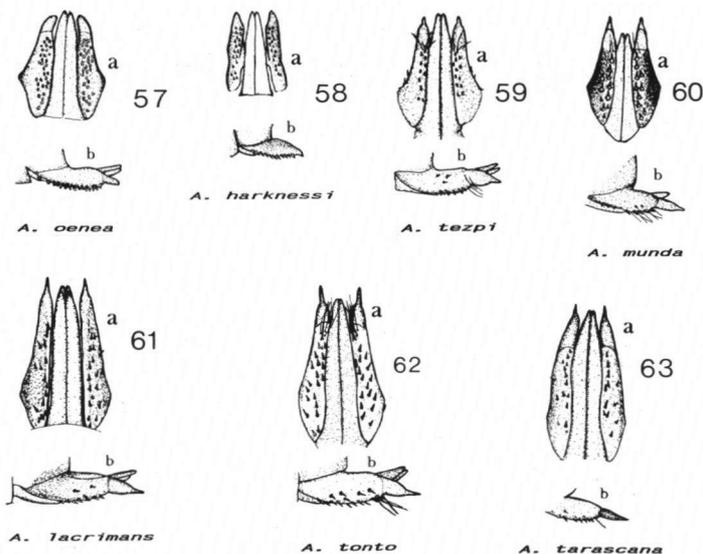
Head - as in *A. fissa*; labrum pale brown. Antennae 7-jointed (Fig. 22), as long as or slightly shorter than head, pedicel darker than remaining antennomeres, ratio of lengths of antennomeres: 0.25, 0.95, 1.0, 1.0, 0.55, 0.30, 0.25. Labium dark brown, hinge extending to anterior margin of mesosternum; prementum subquadrate, almost as long as wide (Fig. 42), with 14 lateral and 3-4 basidorsal spiniform setae; ligula barely prominent; palpus with 3 long setae, its external border with small spiniform setae, internal and apical borders as in other species.

Thorax - Anterodorsal corners of pronotum with long setae and spiniform setae. Synthorax stout, anterior wing cases not extending to posterior margin of abdominal segment 4, posterior ones slightly exceeding it. Legs yellow, other features as in *A. oenea*; tibiae heavily setose, apical 3-4 spiniform setae very stout, resembling tibial spurs; tarsi with long, delicate setae on dorsum, two ventral rows of long and stout spiniform setae; claws yellow.

Abdomen - brown, with a pale middorsal stripe throughout; tergites 1-4 without setae, spiniform setae on posterior margin of 5-6 and on lateral and posterior margins and dorsum of 7-10, increasing in number, size and robustness posteriorly. Sternites brown, 1-7 with minute setae, 8-10 with large spiniform setae, mainly on posterior margin of 10. Male gonapophyses pyramidal, dark, short, extending posteriorly over basal 0.50 of 10; in ventral view (Fig. 46a) with tips acute and divergent; ventral border with 4-5 spiniform setae over basal 0.40; in lateral view as Figure 46b. Female gonapophyses exceeding posterior margin of 10 for 0.75 length of 10; laterals, in ventral view (Fig. 68a) with long, acute, divergent tips, ventral border with 18-19 spiniform setae; in lateral view as Figure 68b; central ones smooth and shorter than lateral ones, all concolorous. Gills laminar, narrow at base and gradually broadening posteriorly, reaching their maximum width at 0.70 length, then narrowing and ending in a filamentous tip; laterals 2.5 times as long as wide (Fig. 71b), with a lateral carina on each side which extends 0.90 length, parallel to ventral border basally, then gradually curving upward, covered with spiniform setae; dorsal and ventral borders with spiniform setae on basal 0.95, and long and delicate setae intermingled on apical 0.30 and 0.40 respectively, except on apical 0.05. Central one twice as long as wide (Fig. 71a), carinae as in lateral lamellae but running close to dorsal border and curving downward; otherwise like lateral gills. Male cerci enlarged (Fig. 93a), apices long, conic, bluntly tipped (Fig. 93b, d).

ECOLOGY. - *A. rhoadsi* inhabits lagoons and pools formed at edges of streams and rivers. I found ultimate instar specimens clinging to roots of water hyacinth, *Eichhornia* sp., at the edge of a big lagoon. Emergence in laboratory took place between 10:16 - 11:34 h.

DISCUSSION. - *A. rhoadsi* is characterized by a slightly prominent ligula and is similar to *A. pulla*; differences are discussed under *pulla*.



Figs 57-63. Female gonapophyses: (a) ventral view; - (b) left lateral view.

### *ARGIA TEZPI* CALVERT

Figures 12, 25, 34, 44, 59, 80, 94

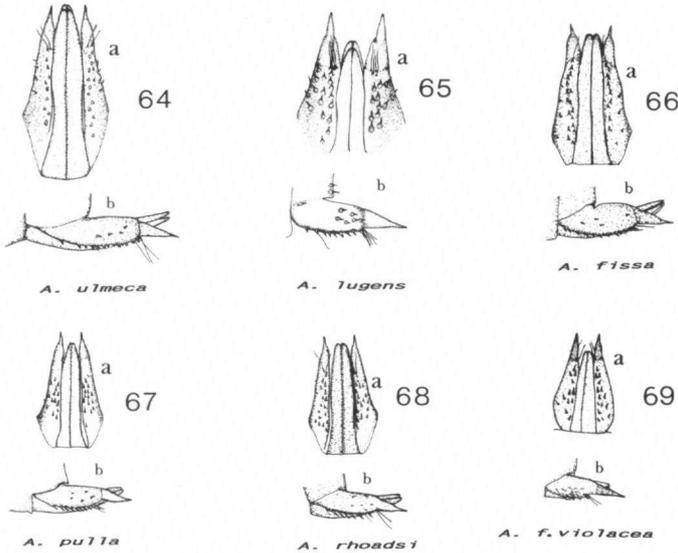
Material - 2 larvae (♂, ♀), 7 exuviae (4 ♂, 3 ♀). MEXICO: Morelos, Palo Bolero (1080 m), 23-II-85, 1 ♂; Tehuixtla (750 m), 14/19-IV-86, 4 ♂; 3 ♀, all R. Novelo leg.; Guerrero, Colotlipa, Río Acingo, 6-XII-86, 1 ♀, S. Ibáñez leg.

**DESCRIPTION.** - Larvae yellow, body slender (Fig. 12).

**Head** - as in *A. fissa*; labrum yellow. Antennae 7-jointed (Fig. 25), slightly longer than head, scape yellow, remaining antennomeres brown but pedicel and first flagellomere a little darker than the others, ratio of lengths of antennomeres: 0.30, 0.50, 1.0, 0.65, 0.35, 0.20, 0.10. Labium yellow, hinge extending to posterior margin of prosternum; prementum longer than wide (Fig. 34a), with 15-17 lateral and 6 basidorsal spiniform setae; ligula prominent; palp a little darker than remainder of labium; with one long seta (Fig. 34b); otherwise as in *A. fissa*.

**Thorax** - Pronotum as in *A. fissa*. Synthorax stout, anterior wing cases extending to posterior margin of abdominal segment 4, posterior ones slightly exceeding it, with alternating pale and dark transversal bands, the dark ones broader. Legs yellow, otherwise as in *A. oenea*.

**Abdomen** - yellow or yellow-brown with a narrow dark stripe; tergites 6-10 with spiniform setae, numerous and stout on lateral and posterior margins, mainly on 8-10; middle part of tergites 2-10 with tufts of long, white setae.



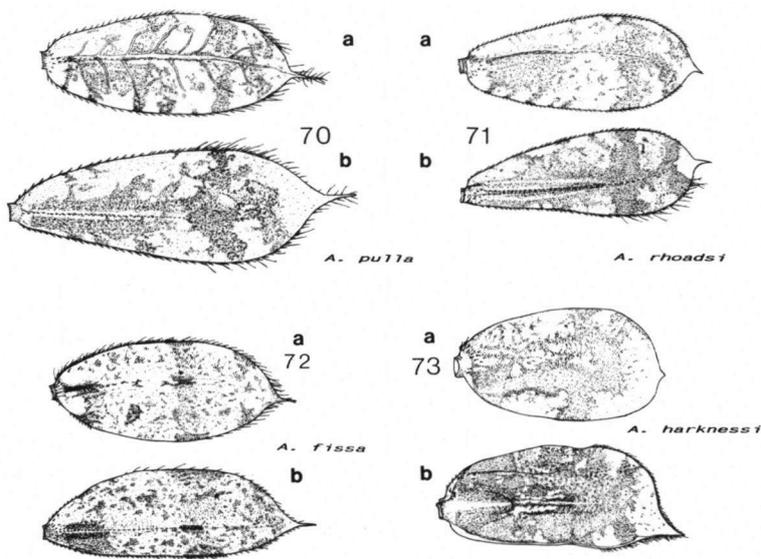
Figs 64-69. Female gonapophyses: (a) ventral view; - (b) left lateral view.

Sternites yellow, 7-10 with spiniform setae, scarce on 7, abundant on 8 and 10. Male gonapophyses conical, short, in ventral view (Fig. 44a) with apices blunt and convergent, extending over basal 0.25 of sternite 10, ventral border with 12-13 stout, claviform setae on basal 0.85 and 2 long setae at base of apical 0.15 (Fig. 44b). Female gonapophyses scarcely exceeding posterior margin of 10; laterals, in ventral view (Fig. 59a) with blunt, parallel, nipple-like tips, ventral border with 12-14 claviform setae on basal 0.70 and 3-4 long setae at base of apical 0.30; external side with 3-5 spiniform setae; in lateral view as Figure 59b; central ones smooth and as long as lateral ones. Gills laminar (Fig. 80), lanceolate, soft, translucent, with profuse and quite evident tracheation, ending in a small filamentous tip; two dark transversal wide bands, one at middle and the other at apical 0.20. Lateral lamellae (Fig. 80b) 3 times as long as wide with dorsal and ventral borders more or less parallel, with minute spiniform setae on basal 0.05 and 0.10 respectively, remainder smooth except minute white setae on apex. Central one two times as long as wide without any kind of setae on borders (Fig. 80a). Male cerci short, globulous, roundly pointed (Fig. 94a, b, d), slightly concave ventrally (Fig. 94c).

**ECOLOGY.** - *A. tezpi* is a stream-dweller although; as was stated by GEIJSKES (1946) for *A. translata*, its general appearance resembles the common type of coenagrionid nymphs living in standing water. Individuals were found clinging under rocks and among gravel. Adults are year-round in Morelos (GARCIA,

1987) and emergence probably occurs throughout the year. Emergence in the laboratory was observed between 12:19 -13:05 h.

DISCUSSION. - *A. tezpi* belongs to the group with a prominent ligula and one palpal seta. It is easy to separate from all other species (except *translata*) by the conspicuous gill tracheation. Larvae of *tezpi* can be distinguished from *translata* by the bluntly-tipped gonapophyses with 12-14 setae on the ventral border in both sexes of the former species, against the sharply-pointed gonapophyses and 3-4 setae on the ventral border in both sexes of *translata* according to GEIJSKES' (1946) description.



Figs 70-73. Gills, lateral view: (a) central lamellae; - (b) left lamellae.

### ARGIA ULMECA CALVERT

Figures 14, 23, 36, 54, 64, 83, 90

Material - 4 exuviae (2 ♂, 2 ♀). MEXICO: Hidalgo, Pemuxtitla, Río Zacuala (1000 m), 18/20-IV-84, 1 ♂, 2 ♀. R. Novelo leg.; Tlanchinol (1500 m), 26-IV-84, 1 ♂, V. Garcia & R. Novelo leg.

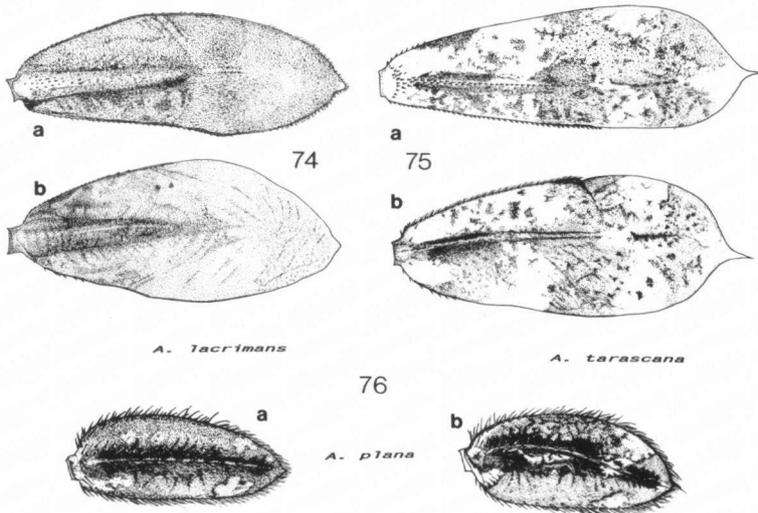
DESCRIPTION. - Exuviae amber-colored, body slender and enlarged (Fig. 14).

Head - as in *A. fissa*; labrum yellow-brown. Antennae 7-jointed (Fig. 23), longer than head, scape yellow, remainder of antenna brown, ratio of length of antennomeres: 0.35, 0.55, 1.0, 0.80, 0.40, 0.25, 0.15. Labium yellow-brown, hinge extending to anterior margin of mesosternum; prementum longer than wide with 16 lateral and 5-7 basidorsal spiniform setae; ligula prominent; one long

palpal seta and usually 3 small setae (Fig. 36); other features as in preceding species.

**T h o r a x** - Pronotum as in *A. fissa*. Synthorax yellow-brown without conspicuous marks; anterior wing cases exceeding slightly beyond abdominal segment 3, posterior ones extending to 0.50 of 4. Legs yellow, otherwise as *A. fissa*; tarsi yellow-brown; claws red-yellow.

**A b d o m e n** - yellow-brown, segments 7-10 slightly darker; a middorsal pale spot on 4-10 occupying almost the entire length of each tergite; sides of 2-10, posterior margins of 7-10 and dorsal surface of 8-10 with spiniform setae, remainder of abdomen with setae which are long on middorsal line. Sternites 1-6 with small delicate setae; spiniform setae on sides and posterior margin of 7 and on 8-10. Male gonapophyses pyramidal, extending over basal 0.50 of sternite 10, in ventral view (Fig. 54a) with apices sharp and slightly divergent, its ventral border with 16-18 spiniform setae on basal 0.66 and 2 or 3 setae at base of apical 0.35; in lateral view as Figure 54b. Female gonapophyses exceeding posterior margin of 10 for 0.15 length of 10; laterals, in ventral view (Fig. 64a) with long, sharp, parallel tips, ventral border with 12-13 spiniform setae and 4-5 on external side; 2-3 long setae at base of apical 0.25; in lateral view as Figure 64b; central ones smooth and same length as lateral ones. Gills laminar (Fig. 83), dark, with six irregular pale areas, one basal, one apical, two on dorsal margin and two on the ventral one, gills tapering posteriorly in filamentous tips; dorsal and ventral borders more or less parallel; lateral ones 4 times as long as wide (Fig. 83b), dorsal and ventral borders with spiniform setae on basal 0.09 and 0.15 respectively,



Figs 74-76. Gills, lateral view: (a) left lamellae; - (b) central lamellae.

apical 0.31 of dorsal one and apical 0.85 of ventral one with long, delicate, white setae; external side with three rows of spiniform setae on basal 0.25. Central gill with spiniform setae on extreme base of dorsal border with long delicate setae beyond (Fig. 83a); setae on basal 0.16 of ventral border, then smooth with more setae on apical 0.33. Male cerci roundly pointed, slanting dorsally (Fig. 90a); in posterior view with inferior border slightly concave (Fig. 90c).

**ECOLOGY.** - Larvae of this species inhabit small rocky streams; they emerge on exposed rocks and molt in a nearly vertical position. One male was observed in the field immediately after transformation at 12:30 h on April 26, 1984 at a shaded stream in the pine-oak forest at Tlanchinol, Hidalgo, during the dry season.

**DISCUSSION.** - Larvae of *A. ulmeca* are similar to *A. oculata* described by LIMONGI (1983), and share the following features: one long palpal seta plus 3 small setae, ligula very prominent, size and shape of male and female gonapophyses, and shape and coloration of gills. They probably differ in male cerci but specimens of *oculata* were not available for analysis.

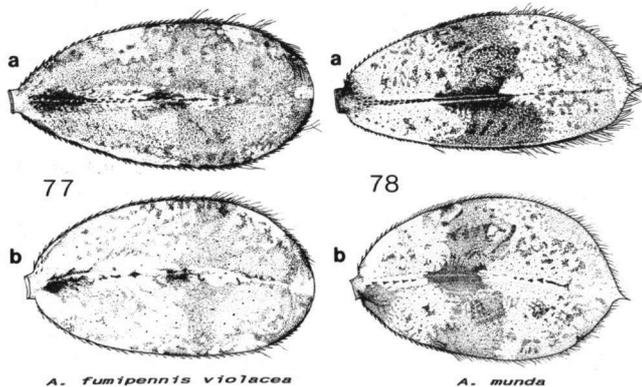
#### ARGIA MUNDA CALVERT

Figures 6, 15, 29, 55, 60, 78, 86

**Material.** - 63 larvae (28 ♂, 35 ♀), 1 exuvia (♀). MEXICO: Durango, La Michilia, Ciénega de Los Caballos, 12-IV-87, 1 ♀; arroyo El Taray, 14-IV-87, 1 ♂; arroyo Corralitos, 16-IV-87, 7 ♂, 10 ♀; arroyo El Temazcal, 10-XII-87, 20 ♂, 20 ♀; - km 67 Rt. Súchil-Mezquitlan, 5 ♀. All R. Novelo & E. González leg.

Larva shown in Figure 6. The following amplifies the description by WESTFALL (1990).

**H e a d** - Although Westfall indicates the absence of noticeable setae on margins,

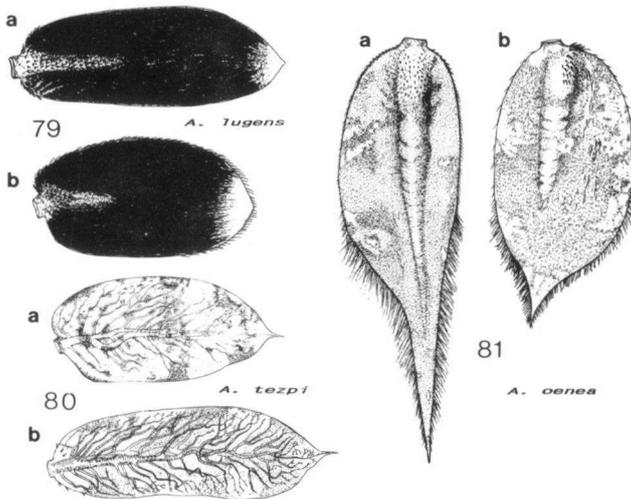


Figs 77-78. Gills, lateral view: (a) left lamellae; - (b) central lamellae.

they were present in specimens that I examined. Likewise, all specimens I saw had 7-jointed antennae (Fig. 15), with ratio of lengths of antennomeres: 0.45, 0.70, 1.0, 0.85, 0.60, 0.40, 0.25.

**A b d o m e n** - Sides and sternites 1-10 and dorsum and posterior margins of 6-10 with abundant spiniform setae, dorsum and posterior margins of 1-5 with abundant delicate setae. Male gonapophyses pyramidal, extending over 0.70 length of sternite 10; in ventral view (Fig. 55a) with sharp parallel tips, ventral borders with numerous spiniform setae on basal 0.60; in lateral view as Figure 55b. Female gonapophyses exceeding posterior margin of 10, laterals, in ventral view (Fig. 60a) blunt-tipped and parallel, ventral border with numerous spiniform setae on basal 0.70 and 3-4 long setae at base of apical 0.25. Central ones smooth, shorter than lateral ones; in lateral view as Figure 60b. Male cerci short, spherical, concave ventrally (Figs. 86a-e).

**ECOLOGY.** - As stated for *A. f. violacea*. Emergence was observed once at 10:33 h in the laboratory.



Figs 79-81. Gills, lateral view: (a) left lamellae; - (b) central lamellae.

**DISCUSSION.** - Larvae of *A. munda* have a moderately prominent ligula. They are similar to *A. tonto* in the following: antennae uniformly colored, two palpal setae, shape of gonapophyses; but differ in coloration of abdomen and gills, in total length of the body, and stouter spiniform setae on gonapophyses of *tonto*, as well as in the shape of the male cerci.

**ARGIA PLANA CALVERT**

Figures 8, 21, 40, 48, 76, 92

Material. - 1 exuviae (♂). MEXICO: Morelos, Cuautla, Las Tazas (1320 m), 19-II-86, R. Novelo leg.

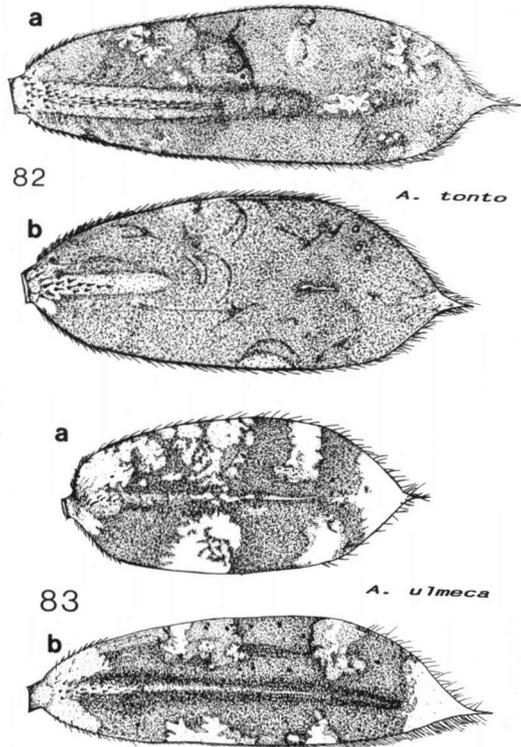
Exuviae shown in Figure 8. The following can be added to WESTFALL'S (1990) description.

**H e a d** - Prementum with numerous, small delicate setae mainly at sides of median sulcus and extending to ligula (Fig. 40); palp with 3 + 5-6 setae.

**A b d o m e n** - Male gonapophyses conical (Fig. 48a, b), small, in ventral view with tips sharp and divergent, scarcely exceeding sternite 9, with abundant long setae on ventral border. Male cerci roundly pointed, subspherical, slightly concave ventrally (Fig. 92).

**ECOLOGY.** - *A. plana* inhabits small streams usually in still water pools with a muddy or gravel bottom. The unique specimen, collected as a last instar larva, was found among decayed leaves. Adults of this species are year-round in Morelos (GARCIA, 1987), so emergence probably occurs throughout the year. Emergence was observed at 13:38 h.

**DISCUSSION.** - Larvae of *A. plana* have a slightly prominent ligula. The closest species is *A. vivida* sharing the following: body short and pubescent, posterior margin of head almost straight, antennae shorter than head, prementum quadrate, shape of male gonapophyses and gills. They differ in antennae 7-jointed, antennal scape pale and palpal setae 2 + 3 or 3 + 5-6 in *plana* against antennae 6-jointed,



Figs 82-83. Gills, lateral view: (82a) left lamella; - (b) central lamella; - (83a) central lamella; - (b) left lamella.

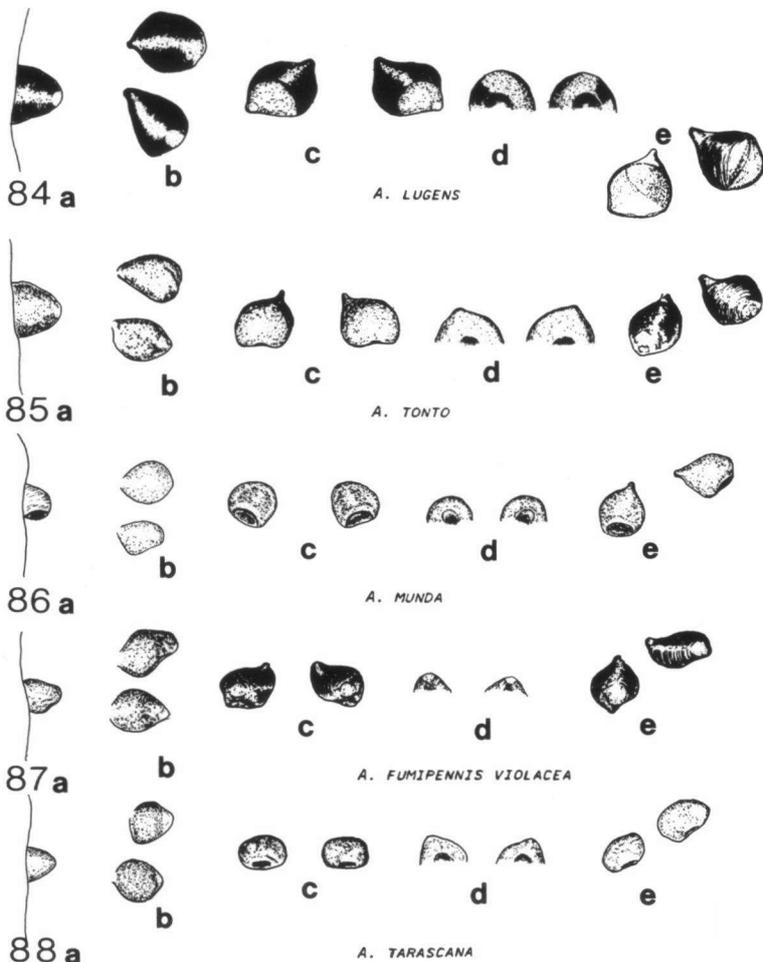
scape dark and palpal setae 4 in *vivida*.

All *Argia* larvae I have seen have minute setae on the dorsal surface of the prementum, but those in *plana* are more conspicuous.

### ARGIA TARASCANA CALVERT

Figures 11, 26, 31, 53, 63, 75, 88

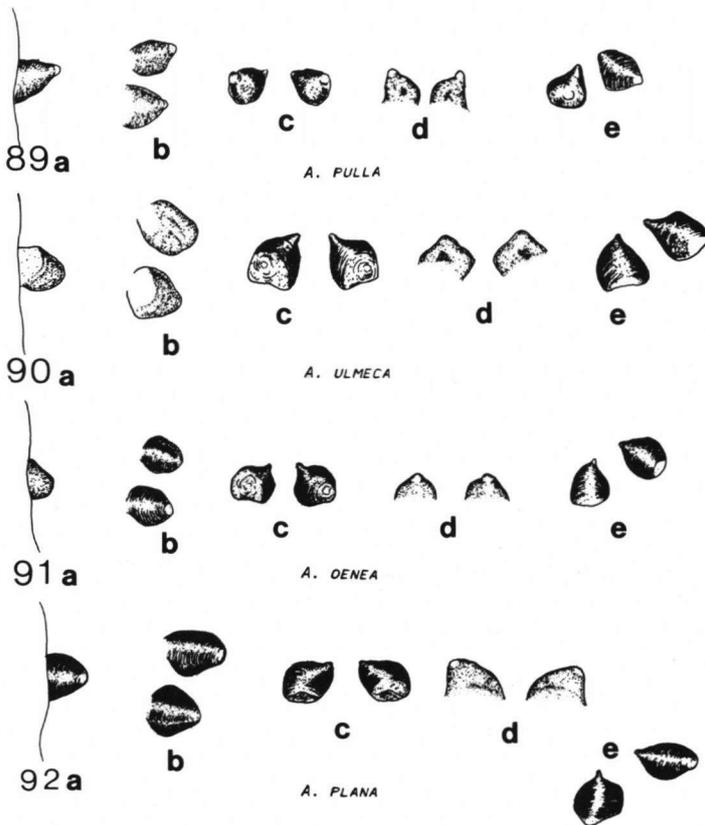
Material. - 3 larvae (2 ♂, 1 ♀), 8 exuviae (5 ♂, 3 ♀). MEXICO: Morelos, San Juan Ahuehuevo (1150 m), 23-II-85, 3 ♂; Temilpa Viejo, Río Yautepec (1210 m), 15-I-87, 1 ♂; 14-II-87, 3 ♂, 3 ♀; Las Estacas (980 m), 8-VII-87, 1 ♀. All R. Novelo leg.



Figs 84-88. Male cerci: (a) lateral; - (b) laterodorsal; - (c) posterior; - (d) ventral; - (e) posterolateral.

Larva shown in Figure 11. The following can be added to WESTFALL's (1990) description.

**A b d o m e n** - Male gonapophyses pyramidal, extending to basal 0.45 of sternite 10, in ventral view (Fig. 53a) with tips sharp and parallel; ventral border with 3-6 spiniform setae over basal 0.50 and 2-3 long setae at base of apical 0.50; in lateral view as Figure 53b: Female gonapophyses exceeding posterior margin of 10 for 0.85 the length of 10; laterals, in ventral view (Fig. 63a) with long, sharp, parallel tips; 10-11 spiniform setae on ventral border and 2-3 on external side; 1-3 long setae at base of apical 0.25; in lateral view as Figure 63b. Central ones smooth and slightly shorter than lateral ones. Male cerci short, globulous, roundly pointed (Fig. 88a); in posterior view with dorsal and ventral margins subparallel (Fig. 88c), slightly concave ventrally; in ventral view, with external borders longer than internal ones (Fig. 88d).



Figs 89-92. Male cerci: (a) lateral; - (b) laterodorsal; - (c) posterior; - (d) ventral; - (e) posterolateral.

**ECOLOGY.** - *A. tarascana* inhabits small streams in lentic zones. They cling to roots, submerged grasses, and decayed leaves on the bottom. Adults are year-round in Morelos (GARCIA, 1987) and emergence probably occurs throughout the year. Emergence was observed between 12:18 - 14:04 h in the laboratory.

**DISCUSSION.** - *A. tarascana* has a moderately prominent ligula. This species seems closest to *A. fissa*, sharing the following features: 3 long setae on palpus, laminar gills laterally carinated with similar arrangement of spiniform setae, and shape of male and female gonapophyses. They differ by shape and color pattern of gills and coloration of antennae, as well as shape of male cerci.

### *ARGIA TONTO* CALVERT

Figures 13, 27, 30, 51, 62, 82, 85

**Material.** - 19 larvae (5 ♂, 14 ♀), 1 exuviae (♀). MEXICO: Durango, La Michilia, arroyo Corralitos, 16-IV-87, 7 ♀; - arroyo El Temazcal, 10-XII-87, 5 ♂, 8 ♀. All R. Novelo & E. González leg.

Larva shown in Figure 13. The following can be added to WESTFALL's (1990) description.

**Head** - Fourteen to sixteen lateral and 6-7 basidorsal spiniform setae on prementum; ligula moderately prominent (Fig. 30).

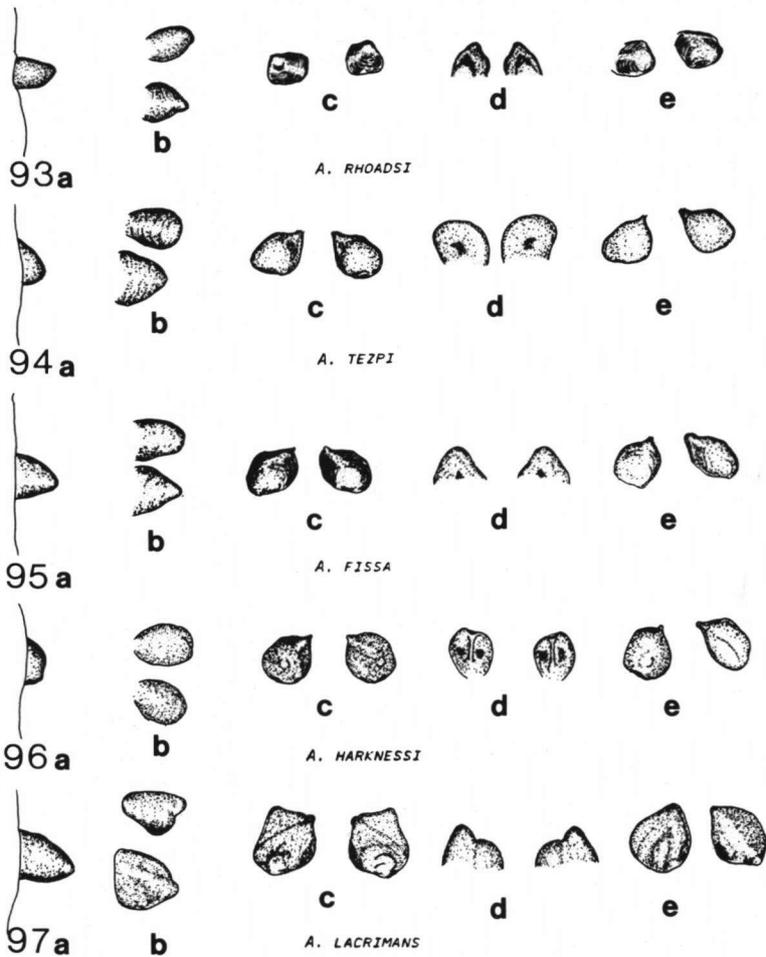
**Abdomen** - Tergites 2-9 with abundant spiniform setae, mainly on lateral and posterior margins, increasing in number and thickness posteriorly. Sternites 1-7 yellow-brown, 8-10 brown; 2-10 with spiniform setae, notably stout on 8-10. Male gonapophyses pyramidal, extending over 0.35 length of sternite 10, in ventral view (Fig. 51a) with tips sharp and slightly divergent; ventral border with 16-17 stout spiniform setae on basal 0.60 and 4-5 long setae at base of apical 0.33; in lateral view as Figure 51 b. Female gonapophyses exceeding sternite 10 for almost 0.50 the length of 10; laterals in ventral view (Fig. 62a) with tips sharp and slightly divergent; ventral border with 19-21 stout spiniform setae on basal 0.66 and 5 long setae at base of apical 0.33. Central ones smooth and shorter than lateral ones; in lateral view as Figure 62b. Male cerci short, tips rounded in lateral and posterior view (Fig. 85a, c), slightly concave ventrally (Fig. 85c); in ventral view with a small lump on apex (Fig. 85d).

**ECOLOGY.** - As in *A. f. violacea*. Emergence was recorded once at 10:02 h.

**DISCUSSION.** - Larvae of *A. tonto* have a moderately prominent ligula. See discussion under *A. munda* and *A. lacrimans*.

### GENERAL DISCUSSION

I separate the species of *Argia* into three groups based on the condition of the ligula (Tab. II). The prominent ligula group has one palpal seta but there is no clear relationship between the condition of the ligula and number of palpal setae



Figs 93-97. Male cerci: (a) lateral; - (b) laterodorsal; - (c) posterior; - (d) ventral; - (e) posterolateral.

in the others. Most of the species I described here have a pale antennal scape, acutely-pointed gonapophyses and acuminate gills; others exhibit unique characters (see discussion under every species). By suggestion of Dr. R.W. Garrison I described the pharate caudal appendages (cerci) of males, a good character to distinguish *Argia* species. This is the first time that the cerci are described for this genus. The male and female cerci of larvae were previously described and used by GARRISON (1981, 1984), as a distinctive character to separate species of *Ischnura* and *Enallagma*.

Table II  
Convexity of ligula in *Argia* larvae<sup>1</sup>

Very prominent	Moderately prominent	Slightly prominent
<i>concinna</i>	<i>fissa</i>	<i>fumipennis</i>
<i>difficilis</i>	<i>munda</i>	<i>lacrimans</i>
<i>emma</i>	<i>tarascana</i>	<i>nahuana</i>
<i>harknessi</i>	<i>tonto</i>	<i>plana</i>
<i>insipida</i>		<i>pulla</i>
<i>moesta</i>		<i>rhoadsi</i>
<i>oculata</i>		<i>sedula</i>
<i>oenea</i>		
<i>tezpi</i>		
<i>translata</i>		
<i>ulmeca</i>		

<sup>1</sup> *apicalis*, *sordida* and *tibialis* were not available for analysis.

My field experience shows emergence of *Argia* to occur around noon, a typical strategy of odonates from cool climates where conditions become favourable during this time (CORBET, 1962). This regime is at variance with most tropical Odonata which emerge and molt at night (Anisoptera) or at dawn (Zygoptera) (CORBET, 1962, 1980), presumably when diurnal predators (birds and mature adult dragonflies) which hunt by sight are less active (CORBET, 1962). I have never observed any *Argia* emerging at these times. The reasons for diurnal emergence in *Argia* are unknown but emerging individuals may require a certain threshold of temperature for ecdysis as occurs in *Anax junius* (CORBET, 1980).

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