

Description of the larva of *Argia jujuya* Ris (Coenagrionidae) with a key to species from the Argentinean Yungas cloud forest

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(Received 31 July 2013; final version received 26 September 2013)

The previously unknown larva of *Argia jujuya* Ris, 1913 is described, diagnosed and illustrated. Among other characters, the following combination is important to distinguish it from other species in the genus: antennae with six concolorous segments, ligula projected only slightly, row of small premental setae present, abdominal sternum 8 almost entirely covered with spiniform setae, gonapophyses with pointed apices slightly diverging distally, cercus triangular, caudal lamellae subequal in length and triquetral along entire length, with fringe of stout setae along entire dorsal and ventral margins. Larvae were collected in very small and thickly vegetated streams, with low water current. A key for the three species known as larvae in NW Argentina is presented.

Keywords: Odonata; Zygoptera; damselfly; *Argia joergenseni*; *Argia translata*

Introduction

Argia Rambur is a speciose genus of Coenagrionidae with a wide distribution in North and South America (Garrison, 1994). Of the 118 species of *Argia* currently recognized, larvae from 45 species (38%) are known (Caesar & Wenzel, 2009; Costa, Ravanello, & Souza-Franco, 2008; De Marmels, 2012; Garrison, von Ellenrieder, & Louton, 2010; Meurgey, 2011; Novelo-Gutiérrez, 1992, 2008; Novelo-Gutiérrez & Gómez-Anaya, 2012; Pérez-Gutiérrez & Montes-Fontalvo, 2011) and knowledge about their ecology and behavior is scarce, especially in the the Neotropics. *Argia jujuya* Ris is known only from Northwestern Argentina, mainly from mountain cloud forests known as Yungas but also from drier habitats (von Ellenrieder & Garrison, 2007a). The Yungas biogeographic province (Amazon subregion; Morrone, 2001) is a biodiversity hotspot located along the eastern slopes of the tropical and subtropical Andes. In its southernmost portion (S Bolivia and NW Argentina) it is formed by isolated patches of forest, with numerous endemic species of aquatic insects (Garrison & von Ellenrieder, 2007; Molineri, 2010; von Ellenrieder, 2009; von Ellenrieder & Garrison, 2007b; von Ellenrieder & Muzón, 2008). *Argia* includes four known species in the Yungas from Argentina (some of them extending also to other ecoregions of NW Argentina): *A. joergenseni* Ris, 1913, *A. jujuya* Ris,

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A. translata Selys, 1865 and *A. yungensis* Garrison & von Ellenrieder, 2007. Until now only the larvae of *A. translata* and *A. joergenseni* were known (Geijskes, 1946; von Ellenrieder, 2007).

The aim of this work is to describe and illustrate the larva of *A. jujuya* and provide a key to the three known larvae of the genus recorded from the Yungas of Argentina. Additionally we give physical and chemical data of its larval habitats.

Materials and methods

Terminology used in the description is from von Ellenrieder (2007) and Novelo-Gutiérrez (1992, 2008). The larvae of *Argia jujuya* were collected with hand nets, taken to the laboratory and reared in individual plastic containers with perforated walls in an aquarium. Teneral adults were maintained alive for 24 hours before preservation in 96% ethanol, with their respective larval exuviae. Morphological description, measurements and cuticle pigmentation are from F0 reared exuviae only. Comments on hypodermal coloration are from younger larvae (as in Figure 1). Measurements were taken as follows: total length (in dorsal view, from anterior margin of labrum to end of abdominal tergum 10), head width (maximum width between outer margin of eyes). Mandibular formula is from Watson (1956). Mouthparts, gonapophyses, and caudal lamellae were dissected from a larval exuvia and temporarily mounted in glycerin for observation, and photographed under a microscope (Olympus BX51, Japan) and/or a stereo microscope (Nikon 20154, Japan) with the aid of an attachable camera (Nikon D5000, Japan). Some stacked, extended depth of field pictures were obtained using Combine ZP software (Hadley, 2008, available at www.hadleyweb.pwp.blueyonder.co.uk). All material is deposited in the Instituto de Biodiversidad Neotropical, Facultad de Ciencias Naturales e IML, Universidad Nacional de Tucumán, Argentina.

Larva of *Argia jujuya*

Material examined

Two reared female adults with corresponding larval exuviae (specimens 1 and 2 in Table 1) from Argentina, Tucumán Province, Raco, unnamed swamp on provincial route 340, 11 March 2013, 1200 m, 26°41'43" S, 65°23'12" W, C. Molineri col.; 4 young larvae same data as above except date 25 April 2013; and 3 young larvae and one reared female adult with corresponding larval exuvia (specimen 3 in Table 1) from Argentina, Tucumán Province, Yerba Buena, roundabout at foot of hill, unnamed stream, 24 April 2013, 500 m, 26°48'3" S, 65°19'0" W, C. Molineri col.

Description of female last instar larva (Figures 2–18)

Head. Trapezoidal, wider than long (maximum width/length 1.5–1.7), with posterior margin slightly concave, cephalic lobes with stout setae (Figure 2). Ventrally with 9–10 stout setae between margin of eye and mandibular base. Antennae (Figure 3) 6-segmented, longer than head, with antennomere 3 the longest, 0.70–0.85 times the length of antennomeres 1 + 2 combined (Table 1). Labrum with broad anteromedian emargination, lateral margins rounded (Figure 7). Hypopharynx (Figure 8) subquadrate, medially convex on anterior margin, lateral lobes rounded with 7 strong marginal setae, ventral surface with a diagonal row of 4–5 strong setae and marginal row of 15–20 very thin setae. Maxillae (Figure 13) cardo with stout spine-like setae directed posteriorly; stipes

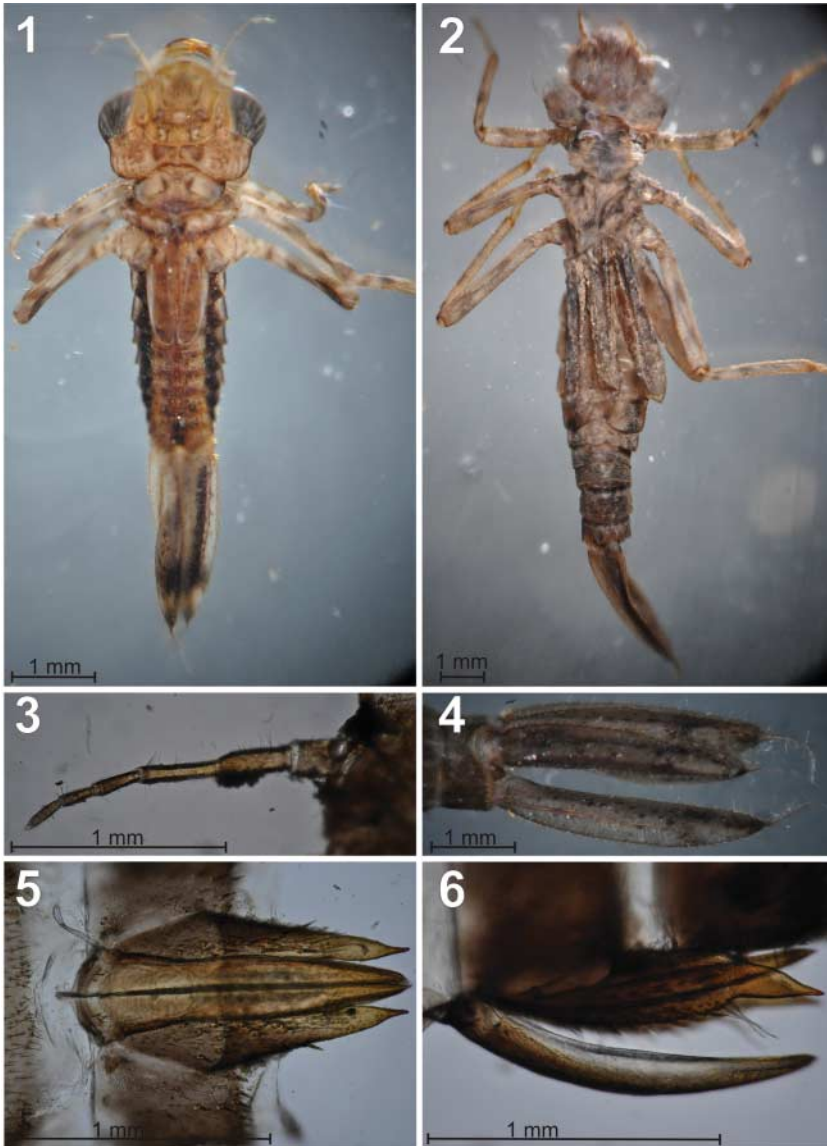
Table 1. Measurements (mm) of the exuviae of the three female last instar larvae. Body length does not include appendages. See the list of material for locality data of each specimen.

	Specimen 1	Specimen 2	Specimen 3
Total length	10.0	9.8	12.0
Inner wingpads	4.0	4.0	4.5
External wingpads	3.8	3.6	4.1
Femur I	1.6	1.6	1.8
Femur II	2.0	2.1	2.5
Femur III	2.5	2.7	3.0
Lateral caudal lamellae (filament)	3.3 (1.1)	3.3 (1.0)	3.3 (0.7)
Medial caudal lamella (filament)	3.3 (1.0)	3.1 (0.8)	3.2 (0.7)
Prementum length	2.0	2.1	2.1
Prementum max. width	1.9	1.9	2.0
Antennae total	1.31	1.41	1.57
Antennomere 1	0.15	0.15	0.19
Antennomere 2	0.26	0.32	0.35
Antennomere 3	0.35	0.34	0.38
Antennomere 4	0.25	0.28	0.30
Antennomere 5	0.14	0.17	0.19
Antennomere 6	0.15	0.16	0.16

with a row of setae on outer margin, with a subbasal group of 4–5 setae on ventral surface, near to this group a longer seta is present toward inner margin, a similar long seta is present subapically on ventral margin; galea strongly toothed with five large teeth directed medially, and with many weaker setae; lacinia with pointed sclerotized apex, almost completely covered with setae. Mandibles (Figures 9–12) with mandibular formula: L 1' 1234 0 a b, R 1' 1234 y 0 a. Prementum (Figure 14) ventral surface with scattered thin setae, mainly on distal 1/3; dorsal surface with a group of 11–13 small laterobasal setae (“basidorsal” setae) and more distally with a submedian group of 6 small setae (“mediolateral” setae, arrows in Figure 15); dorsal surface of ligula with scattered short setae, lateral margin of prementum with a row of 18–20 spiniform setae; medial margin of palp slightly crenulated (Figure 16); dorsal surface of palp with a median row of 5 thin setae and 2 distal larger setae (palpal setae, arrows in Figure 16); lateroventral surface with many very thin setae.

Thorax. Pronotum trapezoidal with submarginal longitudinal row of spiniform setae; posterolateral margin with spiniform and thin setae; pronotum whitish yellow with a submedian brownish bracket-shaped mark (as in Figure 1), lateral and posterior margins brownish. Wingpads extending to abdominal segment 4. Legs whitish yellow with two irregular brownish bands on femur; tibia with two brownish bands near the base.

Abdomen. Terga light brown except longitudinal blackish bands toward lateral margins (Figures 1, 2); abdominal sterna grayish brown, darker toward lateral margins, except gonapophyses and sternum 10 pale. Sternum 8 covered with spiniform setae, increasing in number posteriorly. Gonapophyses (Figures 5, 6) reaching posterior half of abdominal segment 10, with pointed apices slightly diverging distally; ventral surface of gonapophyses with a longitudinal group of setae, including 12–13 stout spiniform basal setae, and 5–8 slender distal setae. Cerci triangular (Figure 4). Caudal lamellae (Figures 4, 17, 18) triquetral, ending in a filamentous tip; with a mediolongitudinal blackish band from base to subapex, and a transverse blackish band crossing the longitudinal band at apex; filamentous tip basally dark but distally pale (Figure 18). Medial lamella 0.95–1.0× the length of lateral lamella. Caudal lamellae with fringe of stout setae along the entire length of dorsal and ventral margins; thin and long setae are also present in this fringe but only along distal 1/3. Lateral lamella 2.9–3.0× as long as wide; medial lamella 2.8× as long as wide.

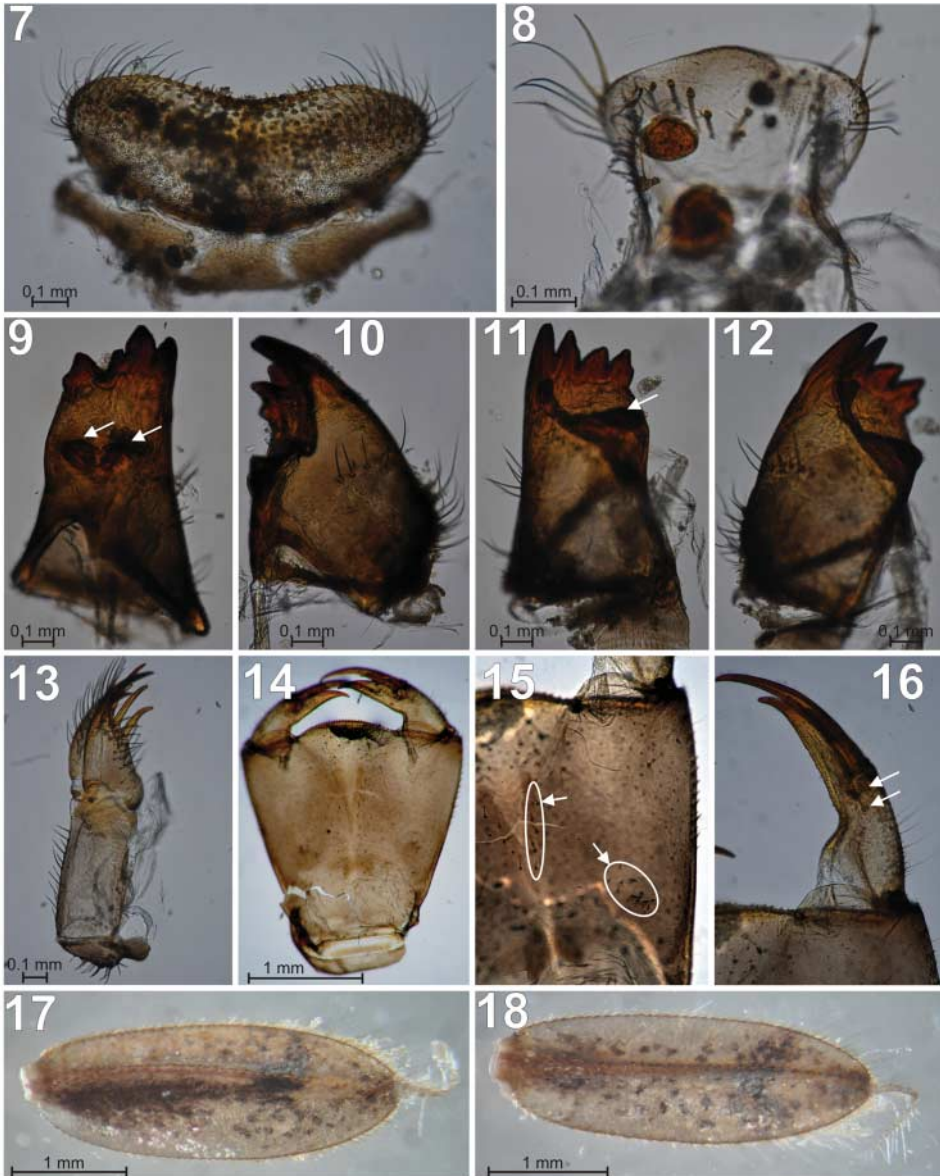


Figures 1–6. *Argia jujuya* Ris, female larva. (1) young larva, dorsal habitus. (2–6) final instar exuviae: (2) dorsal habitus; (3) antenna, dorsal view; (4) caudal lamellae, dorsolateral view; (5) gonapophyses, ventral view; (6) same, lateral view.

Measurements and variations (Table 1). Total length of body without appendages, 9.8–12.0 mm. In some specimens the longitudinal band of the lateral lamella may be blurred, presenting only scattered blackish maculae. Arrangement and number of setae almost do not vary in different specimens, small variations were included in the description given above.

Diagnosis

Larvae of *Argia jujuya* can be distinguished from its congeners, especially from other sympatric species, by the following combination of characters: (1) antennae 6-segmented (Figure 3), all segments similar in coloration, antennomere 3 longest (c.0.8 times the length of antennomeres



Figures 7–18. *Argia jujuya* Ris, female larva, final instar exuvia: (7) labrum, dorsal view; (8) hypopharynx, ventral view; (9) left mandible, inner view (arrows indicate denticles a and b); (10) same, ventral view; (11) right mandible, inner view (arrow indicates denticle a); (12) same, ventral view; (13) maxilla, vv; (14) prementum, vv; (15) prementum, detail, dorsal view (circles indicate groups of setae); (16) labial palp, vv (arrows indicate palpal setae); (17) medial lamella; (18) lateral lamella.

1 + 2, Table 1); (2) ligula only slightly projected (Figure 14); (3) prementum dorsally with groups of short setae on basal, medial and apical regions (Figures 14, 15); (4) sternum 8 almost entirely covered with spiniform setae; (5) gonapophyses (Figures 5, 6) with pointed apices slightly diverging distally, ventral surface with a longitudinal group of 12–13 stout spiniform setae in two rows, continuing distally as a group of slender setae; (6) cerci triangular (Figure 4); (7) caudal lamellae (Figures 4, 17, 18) subequal in length, triquetral along entire length and with fringe of stout setae along entire dorsal and ventral margins, with a terminal filament.

Biology

Larvae were collected in very small, first order streams (0.3 m wide, 0.05–0.10 m depth), strongly vegetated with rooted aquatic and semiaquatic plants. Mature larvae positioned near the surface hanging from submersed portions of emergent plants. Water flow was very low (less than 0.1 m s⁻¹), water temperature varied from 10 to 25°C in the season of collection. The range of other water variables measured once (on 18 April 2013) with an HORIBA U-52 multi-analyzer (Japan) in both localities reported here were (first value from Yerba Buena, second value from Raco): pH 7.3–8.4, conductivity 0.411–2.780 mS cm⁻¹, DO 7.0–7.4 mg l⁻¹ (64–72% saturation), total dissolved solids 0.25–1.78 g l⁻¹. At the time of collection, adults were not observed around the larval habitat.

Among the four species of *Argia* reported in the region (NW Argentina), *A. jujuya* occupies the smallest range (von Ellenrieder, 2009; von Ellenrieder & Garrison, 2007b), and it is not as frequent and abundant as other species.

Key to the larvae of Argia of the Argentinean Yungas

The larval key to all known Odonata species from the Yungas published by von Ellenrieder & Garrison (2007a) is modified here to include the larva of *A. jujuya*.

- 1. Abdominal sternum 8 bare, without spines; gonapophyses with single ventral row of spines, apices divergent and acutely pointed; antennal segment 3 longer than 1 + 2 *A. translata*
- 1'. Abdominal sternum 8 with spines at least on distal half; gonapophyses with 2–3 ventral rows of spines, apices variable (blunt or pointed); antennal segment 3 subequal to shorter than 1 + 2 2
- 2. Antennae with seven segments, the basal one much paler than the apical ones; ligula strongly convex; one palpal seta; sternum 8 with blunt spines on distal half; gonapophyses with blunt apices, not diverging distally *A. joergenseni*
- 2'. Antennae with six concolorous segments; ligula slightly convex (Figure 14); with two palpal setae (Figure 16); sternum 8 completely covered with spiniform setae; gonapophyses with acute apices, diverging distally (Figures 5, 6) *A. jujuya*

Discussion

Argia jujuya is known from NW Argentina, where it is sympatric with three other species of the genus: *A. joergenseni*, *A. translata* and *A. yungensis*. With the present contribution, only the larva of *A. yungensis* remains unknown. The other two known larvae in the region (*A. joergenseni* and *A. translata*) show a strongly convex ligula, thus being easily distinguished from that of *A. jujuya*. Larvae of this last species are similar to *A. translata* in the pointed gonapophyses with distally diverging apices and triangular female cercus, but differ in the length of median caudal lamella (subequal to lateral lamella in *A. jujuya*, versus markedly shorter in *A. translata*), sternum 8 with numerous scattered setae (smooth in *A. translata*) and other characters given in the diagnosis. But as we compare our larvae only with larvae of the other sympatric species, some characters of the diagnosis should be followed with care to distinguish it from other species, especially the setae on the dorsal surface of the prementum (a feature infrequently described).

Novelo-Gutiérrez (1992) proposed three groups of species based on the degree of convexity of larval ligula. *Argia jujuya* shows a ligula slightly prominent, as do *A. fumipennis* (Burmeister, 1839), *A. lacrimans* (Hagen, 1861), *A. nahuana* Calvert, 1902, *A. plana* Calvert, 1902, *A. pulla* Selys, 1865, *A. rhoadsi* Calvert, 1902 and *A. sedula* (Hagen, 1861). Caesar & Wenzel (2009)

doubted that this single character could strongly define species-groups in the genus, but in their phylogeny of some species of *Argia* distributed north of Mexico, they included only one additional morphological larval character (presence of marginal fringe of stout setae on lateral gills). This situation prevents us from further discussing the relationships of *A. jujuya* until more characters are analyzed simultaneously, and groups of species can be more strongly defined.

Acknowledgements

We are indebted to Natalia von Ellenrieder, Javier Muzón and Eduardo Domínguez for helping in many aspects, especially in gathering the specialized bibliography. We also thank Natalia von Ellenrieder and Rodolfo Novelo-Gutiérrez for the critical reading of the manuscript. The “Instituto de Biodiversidad Neotropical” and the “Fundación Miguel Lillo” (Universidad Nacional de Tucumán, Argentina) provided equipment and granted access to their entomological collections. The National Council of Scientific Research of Argentina (CONICET) is acknowledged for permanent support and scientific grants PIP 2008/1484 and PIP 2011/0330.

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