

DESCRIPTION OF THE LAST LARVAL INSTAR AND
PUPA OF *ASPISOMA FENESTRATA* BLANCHARD, 1837
(COLEOPTERA: LAMPYRIDAE) WITH BRIEF NOTES
ON ITS BIOLOGY

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The last instar larva and pupa of *Aspisoma fenestrata* are described and figured for the first time. Notes for comparison with two other unidentified *Aspisoma* larvae are provided, as well as brief notes on the biology of *A. fenestrata*. Comparison of *Aspisoma* larvae with other known Cratomorphini larvae places *Aspisoma* closer to *Pyractomena* than to *Cratomorphus*.

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There are over 40 genera of fireflies in the Neotropical region, most of which are present in South America. Surprisingly, this contrasts with the very few descriptions of South American lampyrid larvae and pupae. Up to now the only published descriptions are those by Costa *et al.* (1988) and Viviani (1989). In their book, Costa *et al.* (1988) described the larvae and pupae of four lampyrid species. One is *Lucio castelnaui* Kirsch, 1865, but the other three were identified only to genus, and belong to *Cratomorphus* Motschulsky, 1853, *Bicellonycha* Motschulsky, 1853 and *Aspisoma* Laporte, 1833. Viviani (1989) described the larva and pupa of another unidentified *Aspisoma* species.

The genus *Aspisoma* belongs to the subfamily Lampyrinae, tribe Cratomorphini. It includes about 70 species of small to medium-sized fireflies (McDermott 1966), almost all are Neotropical, just one species reaches the Nearctic region (Blackwelder 1945; Poole & Gentili 1996; Lloyd 2002). Only two published descriptions of *Aspisoma* immatures (species unknown) exist (Costa *et al.* 1988; Viviani 1989). Following McDermott (1966), the tribe Cratomorphini includes only five genera, three of which have described immatures (table 1).

In this paper the last larval instar and pupa of *Aspisoma fenestrata* Blanchard, 1837 are described and illustrated. The immatures of *A. fenestrata* are also compared to those of the other two *Aspisoma* species described by Costa *et al.* (1988) and Viviani (1989).

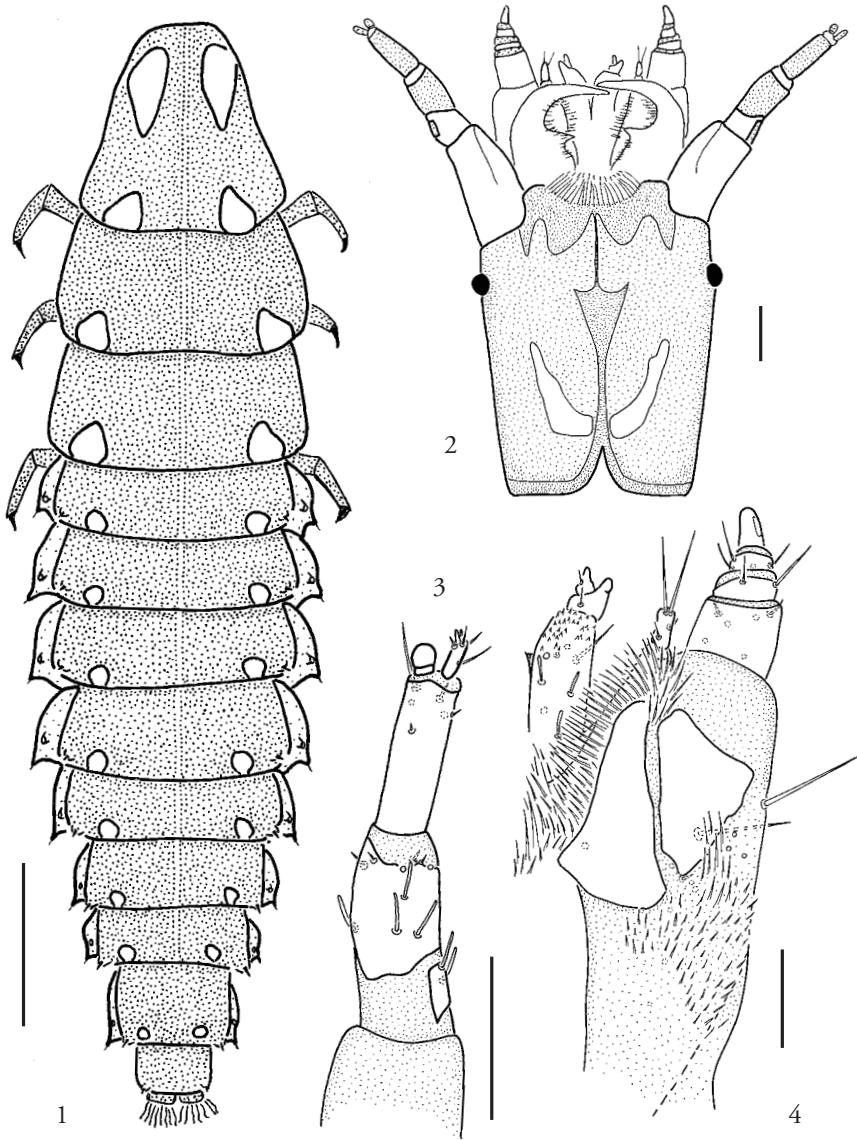
MATERIAL AND METHODS

Two larvae were collected from inside a rotting log partially immersed in a pool of saline temporary water gathered at the sides of a dirt road connecting the locality of Totoralejos with Rd. 60. This locality is within the northeastern limit of a large salt flat, shared by the Argentinean provinces of Córdoba, Catamarca, and La Rioja, known as 'Salinas Grandes'.

The specimens were carried alive to the laboratory in a plastic container. Once in the laboratory they were placed in a larger clear plastic container (20 cm long by 8 cm wide by 9 cm high), with a perforated lid; soil, sand, rotting pieces of wood, and algae from the collection site were used as a substrate for the larvae. The container was slightly inclined in order to provide an artificial littoral habitat, and on one half water and algae were placed, on the other soil, sand, and the pieces of wood. Larvae were fed with freshwater snails.

One mature larva was fixed with boiling water, and stored in 75% alcohol; the other larva was allowed to pupate, and later to complete its metamorphosis to adult in order to assure a correct identification of the species.

Interpretation and terminology of the thoracic and abdominal laterotergites follows Ballantyne & Menayah (2002). Descriptions and drawings were done using a dissecting microscope, and a compound



Figs. 1-4. *Aspisoma fenestrata*, last instar larva. – 1, Habitus; 2, head, dorsal view; 3, right antenna, dorsal view; 4, right half of maxillolabial complex, dorsal view. Figs. 1-2 with sclerotized parts stippled; figs. 3-4 with membranous parts stippled. Scale bars: fig. 1= 2 mm, figs. 2-4= 0.2 mm.

Table 1. Genera of Cratomorphini (*sensu* McDermott 1966) and state of knowledge of their preimaginal stages (morphological descriptions).

Genus	Immatures	References
<i>Cratomorphus</i>	Known	Costa <i>et al.</i> (1988)
<i>Cassidomorphus</i>	Unknown	
<i>Aspisoma</i>	Known	Costa <i>et al.</i> (1988), Viviani (1989)
<i>Pyractomena</i>	Known	Green (1957), Archangel-sky & Branham (1998)
<i>Micronaspis</i>	Unknown	

microscope attached to a camera lucida (Leica DMLB); the drawings were scanned and the plates were put together with Illustrator®.

DESCRIPTIONS

Aspisoma fenestrata Blanchard, 1837 (figs. 1-8)

Material studied. - Argentina, Córdoba province, Salinas Grandes, ditch at intersection of Road 60 and dirt road to Totoralejos, 185 m, 29° 37' 26" S, 64° 50' 23" W, 16.ii.2000. Specimens deposited at the author's collection (MAC).

Last instar larva

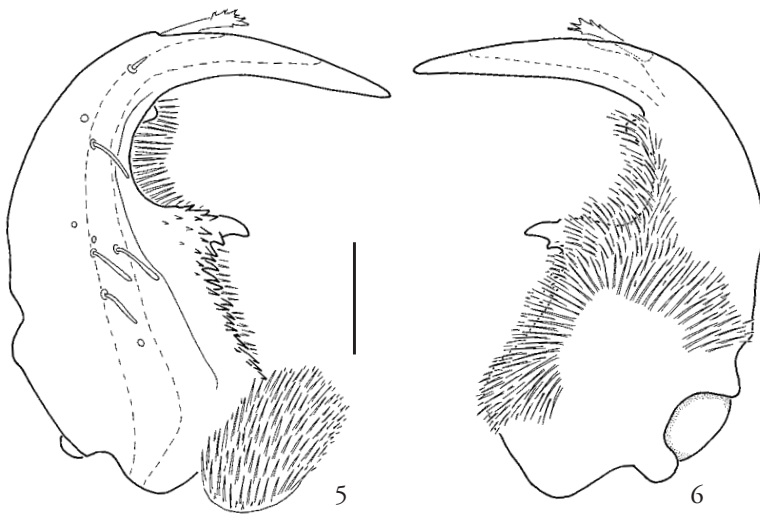
Body elongate, fusiform, slightly flattened dorsoventrally (fig. 1); length: 12.0-13.0 mm (with head capsule retracted). Cuticle of sclerotized areas granulose. Coloration (fig. 1) dark brown except for clear, yellowish spots as follows: pronotum with four spots, two anterior and two posterior, meso- and

metanota each with two spots close to base of segment; abdominal tergites with two small semicircular spots, close to base of segment on each lateral margin; segment nine without spots. Spots on thoracic terga larger than abdominal ones. For a ventral view of *Aspisoma* larva and head refer to Costa *et al.* (1988) and Viviani (1989).

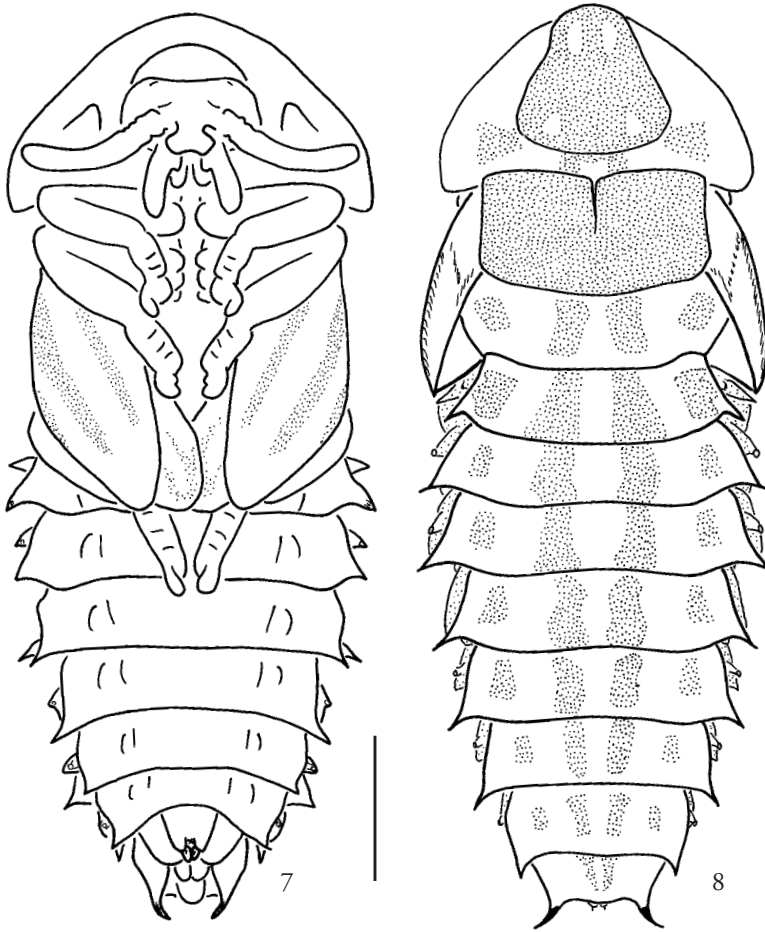
Head capsule: prognathous, narrow, slightly longer than wide, fully retractable within prothorax (fig. 2). Labrum fused to clypeus, covering base of mandibles. Head with one longitudinal internal ridge along midline, extending from occiput to anterior margin; two lateral internal ridges extend from base of head to base of antennae. Epicranial suture vestigial, V-shaped, non-functional. Occiput with dorsal V-shaped incision, from which median internal ridge originates. One stemma on each side of head, posterior to antennal insertions. Epipharynx with two plates covered by microtrichiae, and an anterior brush of long setae, which project past anterior margin of head.

Antenna: partially retractable within membranous base, three-segmented (fig. 3); inserted on lateral distal margins. Basal segment widest, with small basal sclerite on outer margin; five or six stout, blunt setae on dorsal and lateral margins, four more short setae on dorsal and ventral apical margin. Second segment as long as first, narrower, bearing four setae, two dorsal, short, and two ventral, one long and one short. Sensorium of second segment globular, slightly shorter than third segment. Third segment shortest, bearing four short setae and a couple of stout cuticular projections.

Maxilla: five-segmented, attached to labium forming a maxillolabial complex (fig. 4). Cardines subrec-



Figs. 5-6. *Aspisoma fenestrata*, last instar larva. - 5, Left mandible, dorsal view; 6, left mandible, ventral view. Scale bar = 0.1 mm.



Figs. 7-8. *Aspisma fenestrata*, pupa. – 7, Ventral view; 8, dorsal view. Scale bar= 2 mm.

tangular, twice as long as wide. Stipes long, distal half strongly sclerotized and dorsally subdivided in three subtriangular plates, outer one covered by dense pubescence; ventral side of stipes strongly sclerotized throughout; inner margin of stipes densely pubescent. Galea two-segmented, partially covered by pubescence of stipes; first segment wider and slightly longer than distal one; second segment with four setae, two apical, one subapical and one basal, apical ones long. Palpus four-segmented; first segment largest, subquadrate, with two short ventral setae; second and third segments short, wider than long, second segment with two setae, third one with three setae; fourth segment subconical, bare.

Labium: formed by an elongate V-shaped prementum (fig. 4), strongly sclerotized, a long and less scler-

otized mentum and a well sclerotized, small and subtriangular submentum. Cleft of prementum deep, about one fourth of prementum's length; basal two thirds smooth, with few scattered blunt setae, distal part covered by strong, triangular cuticular spines. Ventral face of prementum smooth, with two pairs of setae, inner pair short, outer one long. Mentum long and bare dorsally, with one pair of setae on ventral face. Submentum bare. Palpus two-segmented; basal segment largest, with lateral projection reaching as far as distal end of second segment, bearing one strong dorsal seta; second segment conical, short, with short basal seta.

Mandible: symmetrical, falcate, with inner channel opening subapically on outer edge (figs. 5-6). Two retinacula present, distal one small and blunt, basal

one large and strong, with several cuticular teeth and spines on upper and lower margins, those of lower margin extend to base of mandible. Dorsal surface of mandible with several long, blunt setae (fig. 5); ventral side with a dense brush of slender spines, extending from distal retinaculum to base of mandible (fig. 6). One strong, distally branched hyaline seta or sensory appendage, inserted at base of channel opening, on outer margin.

Thorax: pronotum subtrapezoidal (fig. 1), rounded at corners, at base slightly wider than long, subdivided by fine sagittal line. Meso- and metanota subrectangular, wider than long, with sagittal line. Prosternum subtrapezoidal, poorly sclerotized, extending above and to the sides of coxae, carrying episterna and epimera. Meso- and metasterna poorly sclerotized, subdivided by transverse fold into basisternum and sternellum; basisternum subdivided into three small oval plates; sternellum subdivided into three plates, lateral ones extending above and to the sides of coxae, carrying episterna and epimera. Lateral areas of meso- and metathorax formed by two laterotergites, anterior one of mesothorax bearing biforous spiracle.

Legs: five-segmented, all pairs similar in shape and size. Coxa large, stout; trochanter smaller, subtriangular in lateral view; femur slightly longer than trochanter; tibiotarsus as long as femur, narrower, tapering towards distal end; pretarsus strong, simple, with two basal setae. Coxa, trochanter and femur with few stout setae, tibiotarsus with numerous setae on outer and inner margins, inner margin with two rows of short stout setae.

Abdomen: 10-segmented (fig. 1). Segments I to VII similar in shape and coloration, wider than long, tapering slightly towards end; each tergite subdivided by fine sagittal line; segment VIII narrower, without sagittal line; segment IX with subquadrate tergum, dark, lacking sagittal line. Sternites I to VIII subrectangular, wider than long, and lightly colored; sternite IX well sclerotized, subtrapezoidal, dark with a clear yellowish spot in center. Segment X is a narrow, incompletely sclerotized dark ring, holding the holdfast organ, which has four eversible processes on each side. Pleural suture of segments I to VI subdivide lateral areas into subrectangular upper sclerite, bearing biforous spiracle, and narrow lower sclerite; segments VII and VIII only with upper sclerite. Ventrally, segment VIII carries a pair of small and circular light organs, one on each side.

Description of pupa

Length: 12 mm (figs. 7-8). Aedeagus and exarate, dorsally keeping parts of last larval skin attached to its cuticle (larval pro- and mesothoracic terga). Color yellow, with dorsal brown pattern of longitudinal bands on elytra and tergal plates of thorax and abdomen, sur-

face shiny, covered by sparse and short setae.

Head: small, covered by pronotum in dorsal view. Eyes small, partially covered by antennae. Mouthparts visible in ventral view, antennae short, extending laterally, without reaching sides of pronotum.

Thorax: pronotum large, subtriangular, covering head; meso- and metanotum smaller, subrectangular, bearing wingpads. Wingpads short, reaching distal end of second abdominal segment (first ventrite). Pro- and mesothoracic legs free, visible in ventral view; metathoracic legs almost completely covered by wingpads except for distal segments of tarsi, which extend past second ventrite.

Abdomen: abdominal segments wider than long; tergites I to VIII subrectangular, with posterolateral corners of segments strongly pointed. Sternite I reduced; sternites II to VII (ventrites 1-6) subrectangular, becoming narrower towards end, with posterolateral corners strongly pointed; sternite VIII (ventrite 7) smaller, subcircular. Spiracles: present on abdominal pleural areas of segments I- VIII, first and last abdominal spiracles smaller. (To avoid injuring the pupa, pleura of mesothorax could not be checked for presence of spiracles.)

DISCUSSION

Bionomical notes

Both larvae of *A. fenestrata* were collected from inside a hollow rotting log partially immersed in a pool of saline temporary water. This log housed many freshwater snails, which were the prey of these firefly larvae. During the period in which they were reared, the only preys consumed were snails; cannibalism, something common among other predatory beetle larvae (e.g. Hydrophilidae) was not observed.

Larvae were collected on 16.ii.2000. They were last instars due to the fact that no larval moult was observed in the laboratory. Larvae preyed actively until 2.iii.2000, when they stopped eating and reached the prepupal stage. Pupation took place two days later, on 4.iii.2000, and the adult emerged between 12-13.iii.2000.

My observations agree with the detailed description of the biology of the unidentified *Aspisoma* made by Viviani (1989), and with the brief notes made by Costa *et al.* (1988). The habitat of *Aspisoma* species is similar, near bodies of freshwater, and associated to the littoral or aquatic vegetation. According to Viviani (1989) larvae of the Brazilian species preyed on a variety of snails, and reached the pupal stage in March, as *A. fenestrata* did. The duration of the pupal stage in the Brazilian species ranged between six and 10 days; in *A. fenestrata* the length of the pupal stage was eight to nine days. Costa *et al.* (1988) report duration of the pupal stage of about 10 days.

Comparison with other *Aspisoma* spp.

Few differences could be found among the known *Aspisoma* larvae. The most distinctive difference among the three known *Aspisoma* larvae is the color pattern. In *Aspisoma fenestrata* the tergites are mostly dark, the only clear parts are the sagittal lines and one or two pairs of clear spots on each tergite; in the species described by Costa *et al.* (1988) and Viviani (1989) the sagittal line is present, but the color pattern is more irregular, with several clear markings. A second difference is found in the antenna: in *A. fenestrata* the first segment has a small basal sclerite on the outer margin, in the other two species this segment appears entire.

Regarding the mandibles, both Costa *et al.* (1988) and Viviani (1989) mention the channel opening at the apex of the mandible, but Viviani (1989) illustrates a subapical opening, similar to that of *A. fenestrata*; therefore there may be no difference in the position. None of the other two descriptions mention the hyaline seta present in *A. fenestrata*, but it may have been overlooked by the authors.

Finally, the stipes in *A. fenestrata* has a patch of pubescence on the outer face (dorsal view); this patch seems to be absent in the other two species since the authors do not mention it.

Comparison with other Cratomorphini genera

Table 2 summarizes the main differences among those Cratomorphini genera whose larval stages are known (*Aspisoma*, *Cratomorphus*, and *Pyractomena*). Based on these comparisons, larvae of *Aspisoma* seem closer to those of *Pyractomena* than to the only known *Cratomorphus* larva. This agrees with the cladistic analysis of cantharoid and lampyrid genera carried out by Branham & Wenzel (2001, 2003). These authors

studied the evolution of bioluminescence, basing their study on 85 exemplar taxa and 73 adult characters, and their results show *Aspisoma* and *Pyractomena* as sister groups (two species of each genus were included in the study). According to Branham & Wenzel (2001, 2003), *Cratomorphus* seems more closely related to genera that do not belong to the tribe Cratomorphini (sensu McDermott 1966).

In this paper the terminology used to describe the ventral plates of larvae has been updated to follow the interpretation made by John Lawrence in Ballantyne & Menayah (2002). This can now be applied to previous descriptions (Archangelsky & Branham 1998, 2001; Branham & Archangelsky 2000).

In summary, two important conclusions can be drawn from the present study. The first is the close relationship of *Aspisoma* and *Pyractomena* (based on larval characters); both genera *Aspisoma* and *Pyractomena* share several characters related to the morphology of the head-capsule and mouthparts (table 2), which clearly separate them from *Cratomorphus*. The second conclusion makes reference to the need to revise the current classification of Lampyridae, especially at a subfamily and tribal level, including characters from the immature stages; similar suggestions have been made by Crowson (1972) and also in recent studies (Archangelsky & Branham 2001; Branham & Wenzel 2003).

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Table 2. Comparison among known Cratomorphini larvae.

Character	<i>Aspisoma</i>	<i>Cratomorphus</i>	<i>Pyractomena</i>
Head capsule	longer than wide, well sclerotized	wider than long, partially sclerotized	longer than wide, well sclerotized
Nasale	concave	almost straight, with short median projection	concave
Mandible	with two retinacula, pubescent on ventral side	with one retinaculum, pubescent on both sides	with one retinaculum, pubescent on ventral side
Maxilla	4 th palpal segment conical, galea shorter than palp	4 th palpal segment flat, truncate, galea longer than palp	4 th palpal segment conical, galea shorter than palp
Labium	2 nd labial palp inserted subapically on 1 st	2 nd labial palp inserted apically on 1 st	2 nd labial palp inserted subapically on 1 st
Sagittal line	Present on thoracic and abdominal segments	Absent	Present on thoracic and abdominal segments

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