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New data on the natural history and description of the immatures of *Fulgeochlizus bruchi,* a bioluminescent beetle from Central Brazil (Elateridae, Pyrophorini)

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ABSTRACT

The mature larva and pupa of Fulgeochlizus bruchi *(Candèze, 1896) are described and illustrated. Bioluminescent patterns are also given. Comments, new data on the first instar larva and natural history data are presented. The first instar larvae differ from the mature larvae mainly in their chaetotaxy, which is sparse and more symmetrically distributed.*

Keywords: Agrypninae; Bioluminescence; Larva; Morphology; Neotropical Region; Pupa.

INTRODUCTION

The genus *Fulgeochlizus* Costa, 1975 includes four species distributed from the Brazilian Cerrado to Argentina and Paraguay (Chaco). Although completely pigmented adults have yellow spots on the pronotum, the spots do not present bioluminescence; they emit light only from its abdominal organ, which is very large. Up to now only the first instar larva of *Fulgeochlizus bruchi* (Candèze, 1896) has been described by Casari-Chen & Costa (1986), based on reared material obtained from five females collected by F. Lane from October to November, 1966 at Três Lagoas (Canaã Farm, left bank of the Sucuriu River). In the laboratory, females oviposited about 350 eggs which hatched many first instar larvae. All of them died after a few days and therefore it was impossible to obtain the complete biological cycle.

A total of 184 adults – males and females – of the elaterid beetle *F. bruchi* were collected in several places near Costa Rica, Mato Grosso do Sul, Brazil, by Neide Higashi, from November 05 to 11, 1999. They were brought alive to the Laboratory of Coleoptera Systematic, Evolution and Bionomics of the Museu de Zoologia da Universidade de São Paulo. Several eggs failed to hatch and there was great mortality among the first instar larvae. Only two larvae survived and reached the pupal and adult stages, one after almost five years and the other after six years of maintenance under laboratory conditions. We present herein a review of the first instar larva, descriptions of the mature larva, eggs and pupa, comments on the natural history and description of the bioluminescent patterns reported for the first time for the mature larva and pupa of that species.

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MATERIAL AND METHODS

Adults were maintained alive in the laboratory feeding on sugar syrup. A large number of eggs were obtained, but a lot of them did not hatch. As the first instar larvae were difficult to feed, they were kept in small groups to allow cannibalism and secure at least one second instar. After that, they were fed on collembolan specimens and *Tenebrio* sp. larvae. In spite of the constant care that was taken, there was great mortality among larvae of several instars. Observations of larva and pupa bioluminescent patterns were made mainly in a dark chamber during the day and after sunset.

Larvae were dissected in water, under the stereomicroscope. Temporary slides were mounted in Hoyer's medium. Pictures were taken using a Zeiss Microscope Axionskop 2 coupled to a computer and with a SEM Zeiss LEO 440. Drawings were prepared after photos or made with a camera lucida adapted to a microscope.

RESULTS AND DISCUSSION

Fulgeochlizus bruchi (Candèze, 1896) (Figs. 1-3)

Material examined: BRASIL. Mato Grosso do Sul: Costa Rica, 06-11.XI.1999, Neide Higashi col. 3 eggs, 13 first instar larvae; 1 larva 44 mm long + 7 larval exuviae; 1 mature larva 63 mm long + 10 larval exuviae; 1 mature larva 60 mm long + 10 larval exuviae; 1 pupa + 16 larval exuviae; 1 female adult + 12 larval exuviae + 1 pupal exuvia (MZUSP).

Eggs (Fig. 2A): Diameter length 0.62-0.68 mm. Spherical, pale yellow and smooth at optical microscope (magnification 50-400X), rough with several semispherical papillae at SEM.

First instar larva (Figs. 2B-2F, 3D): Length 2.8-3.1 mm; prothoracic width 0.4-0.45 mm. Head: (Fig. 2B) each side of dorsal surface with one pair of lateral seta basal to the antenna followed posteriorly by a pair of latero longitudinal dorsal setae, a transverse row of five setae and a row of three microsetae; each side of the ventral surface [(fig. 78 in Casari-Chen & Costa (1986)] with two lateroventral setae, one at anterior 1/3 and the other near midlength, and two long setae at the anterior and posterior ends of the hipocephalic carina. Frons (Figs. 2B, 2C): each side with two setae and a microseta anteriorly and a microseta posteriorly; adnasalia with three setae; a single seta between the adnasalia and the nasal and between the nasal teeth; nasal teeth acute, median tooth longer than adnasalia. Antenna (Fig. 2D) with antennomere I glabrous, II with two small setae on each side and a lateroventral sensory as long as the antennomere III; antennomere III with one very long seta and four very small setae. Mandible (Fig. 2D) with a seta on the laterodorsal margin, a small seta on dorsal surface at base, a very small retinaculum (Fig. 3D) and penicillum with two microsetae. Maxillary stipites with two long lateral setae at anterior 1/4; prementum with a pair of setae; postmentum with three pairs of setae: two pairs of stout setae at anterior and posterior ends and one pair of microsetae at midlength. Last labial and maxillary palpomere (Fig. 2F) with several conical and cylindrical sensoria at apex.

Thorax: Pronotum with two pairs of lateral setae and a pair of lateroventral setae on anterior angles, a pair of laterodorsal setae at anterior 1/3, a pair of lateroventral setae at posterior 1/3 and two pairs of lateral setae on posterior angles. Meso- and metanotum with two pairs of lateral setae and two pairs of lateroventral setae at midlength and two pairs of laterodorsal setae: one at anterior 1/3 and the other at posterior 1/3.

Abdomen: Terga I-VIII with a pair of lateral setae and a pair of laterodorsal setae near the anterior margin, two pairs of laterodorsal setae posteriorly; pleura with a long and a short seta; sterna I-VIII with two pairs of lateral setae near the posterior margin. Segment IX (Fig. 2E) tapering to apex, tergum with a pair of parallel urogomphi each one bearing a long seta apically and a long seta inserted on a tubercle adjacent to a spiniform process; basal region to the urogomphi with one median and three lateral pairs of tubercles; the median and first tubercles with a long setae, the third with one long and one very small seta and a short spine; sternum [(fig. 81 in Casari-Chen & Costa, (1986)] with a pair of long setae posteriorly to segment X and one seta in each urogomphus apically. Segment X with two pairs of setae at base, two pairs on anterior margin, a pair laterally near the spine and two pairs on posterior margin.

Remarks: The first instar larvae differ from the mature larvae mainly in the chaetotaxy which is sparse and more symmetrically distributed in the former. These primary setae seem to be more accurately comparable to those of the first larvae of other Pyrophorini species and may provide important ontogenetic and phylogenetic characters for future studies. The most anterior

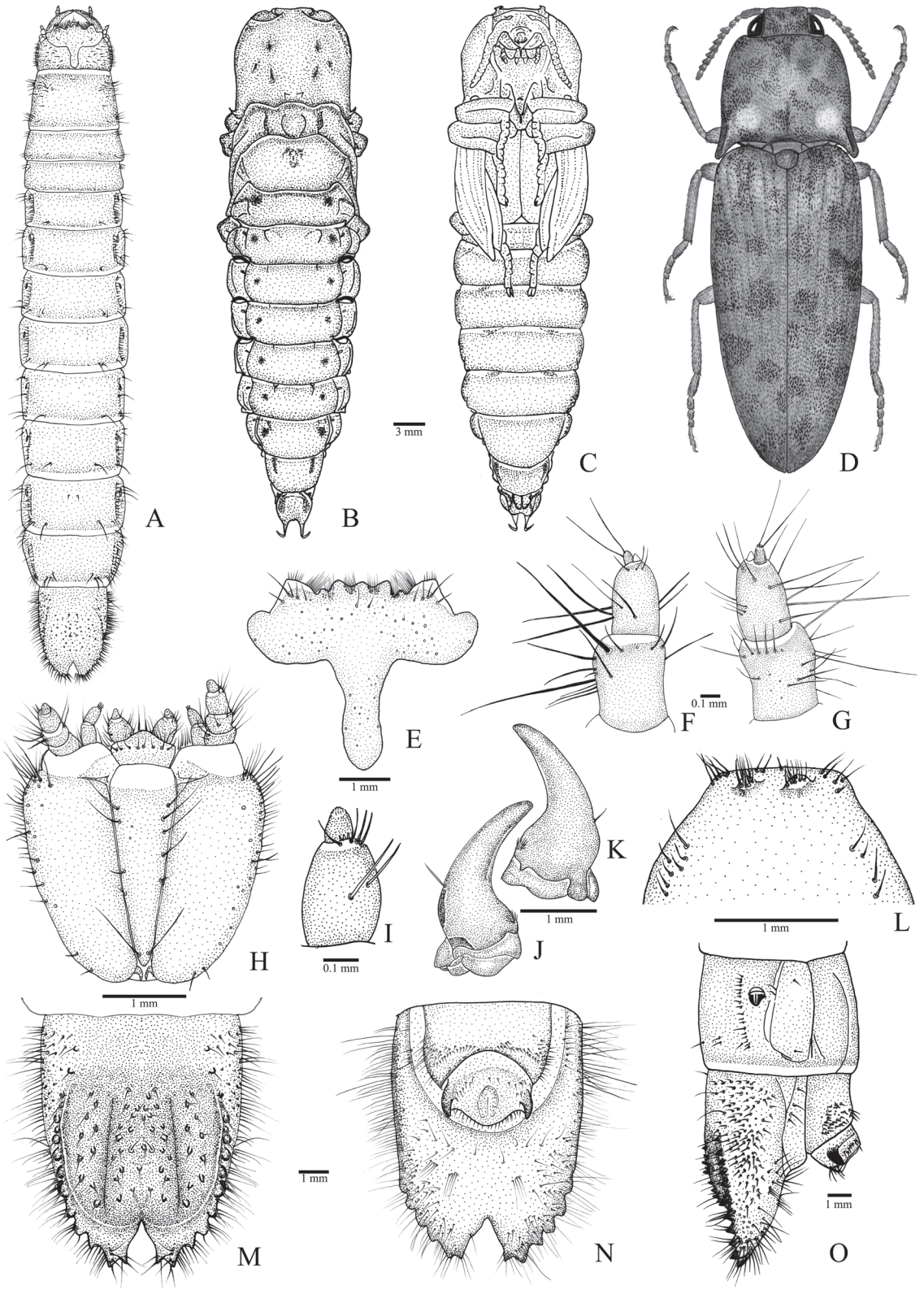

FIGURE 1 : *Fulgeochlizus bruchi.* Mature larva. **A,** ventral habitus; **E,** frons; **F, G,** right antenna (ventral, dorsal); **H,** hypostoma; **I,** labial palpomere; **J, K,** mandibula (dorsal, ventral); **M,** tergum IX; **N,** sternum IX and segment X. Pupa. **B, C,** habitus (dorsal, ventral); **L,** labrum. Adult. **D,** dorsal habitus.

and most posterior of the frontal setae and the posterior longitudinal row of microsetae on the head seem to remain in mature larvae. The posterior pair of setae on postmentum is present in the mature larva as well.

The antennae of the first instar and mature larvae differ greatly in shape and pilosity. The mandible of the first instar larva has one lateral seta as that found in the mature larva, and additionally a small seta on the

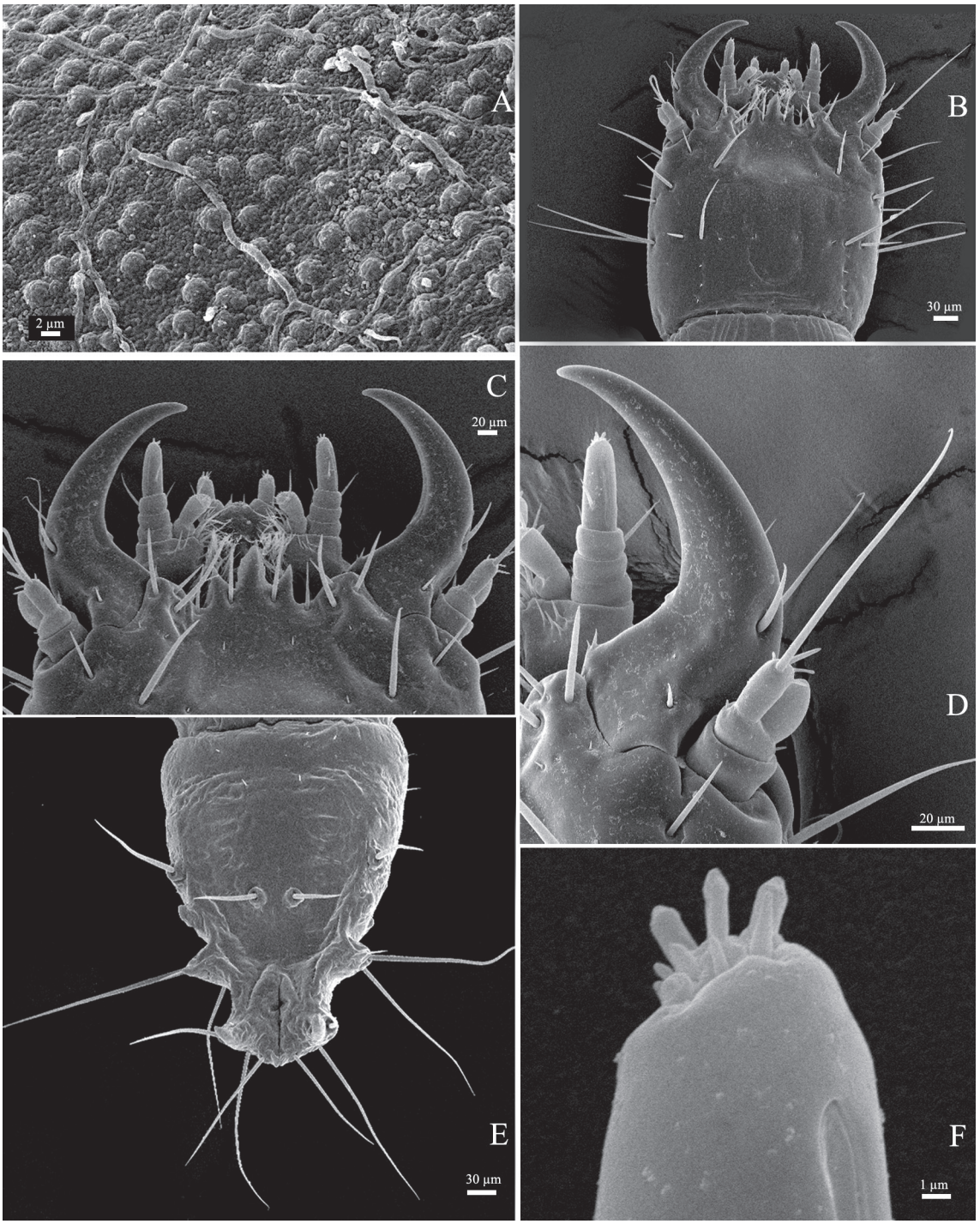

FIGURE 2: *Fulgeochlizus bruchi.* Egg. **A,** corion. First instar larva. **B,** head (dorsal); **C,** nasal and adnasalia; **D,** mandibula and antenna; **E,** tergum IX.

dorsal surface at base. Its penicillum is less pilose, with only two microsetae and a tiny retinaculum is present (Fig. 3D). The setal length and distribution on the thoracic and abdominal segments of the first larva are quite different from the mature larva. Their segments IX and urogomphi differ in shape and in the number of tubercles, the first instar bearing a smaller number. The legs of the first instar larva have a few spines and setae sparsely distributed, not aligned in rows as seen in mature larva.

Mature larva (Figs. 1A, 1E-1K, 1M-1O): Length: 60-63 mm. Body (Fig. 1A) elongate, parallel-sided, flattened. Dorsal and ventral face yellowish, except for light brown pronotum, head and legs dark brown.

Head prognathous, flattened with a longitudinal row of setae laterally and several setae scattered between the frons and lateral borders. Posterior margin straight. Epicranial stem absent. Frontal arms (Fig. 1E) lyriform; a single stemma on each side. Nasal (Fig. 1E) with three teeth, adnasalia as long as or longer than the nasal with five setae. Antennae (Figs. 1F, 1G) densely setose, short, 3-segmented; apical antennomere very short with two long setae apically; segment II with a conical sensorium ventrally and three small ventral apical setae and several short and longer setae widespread; antennomere I with a row of short and long setae along the apical border and several widespread setae basally. Mandibles (Figs. 1J, 1K) wide at base and tapering to apex, unidentate, mesal surface of mandibular base with a small penicillum densely setose with microsetae, lateral margin with one stout seta. Hipocephalic carina almost reaching the posterior margin of head with a row of 14 setae. Ventral mouthparts forming maxillolabial complex (Fig. 1H); maxillae with cardines triangular, narrow and elongate, contiguous to each other at midline; stipites elongate denselly pilose along the lateral border; galea 2-segmented with short spiniform setae apically; palp 4-segmented, pilose. Postmentum triangular widened anteriorly with a row of 4-5 setae laterally and a pair of setae at apex; prementum with a transverse row of setae, ligula very short and rounded apically; labial palps 2-segmented, widely separate, apical palpomere (Fig. 1I) with three basal microsetae and several micro sensoria apically.

Thorax (Fig. 1A): Prothorax as long as meso- and metathorax combined; meso- and metathorax subequal. Pronotum with several setae latero-anteriorly, posterior margin with a longitudinal row of 10 setae lateroventrally and two longitudinal rows of 4-5 setae laterodorsally. Meso- and metanotum scarcely pilose on lateral and anterior margins. Prosternum triangular with four setae on each side of anterior margin and 12-14 setae posteriorly; meso- and metasternum scarcely setose, mesothoracic spiracle lateroventrally located. Leg stout with trochanter; femur and tibia with two rows of

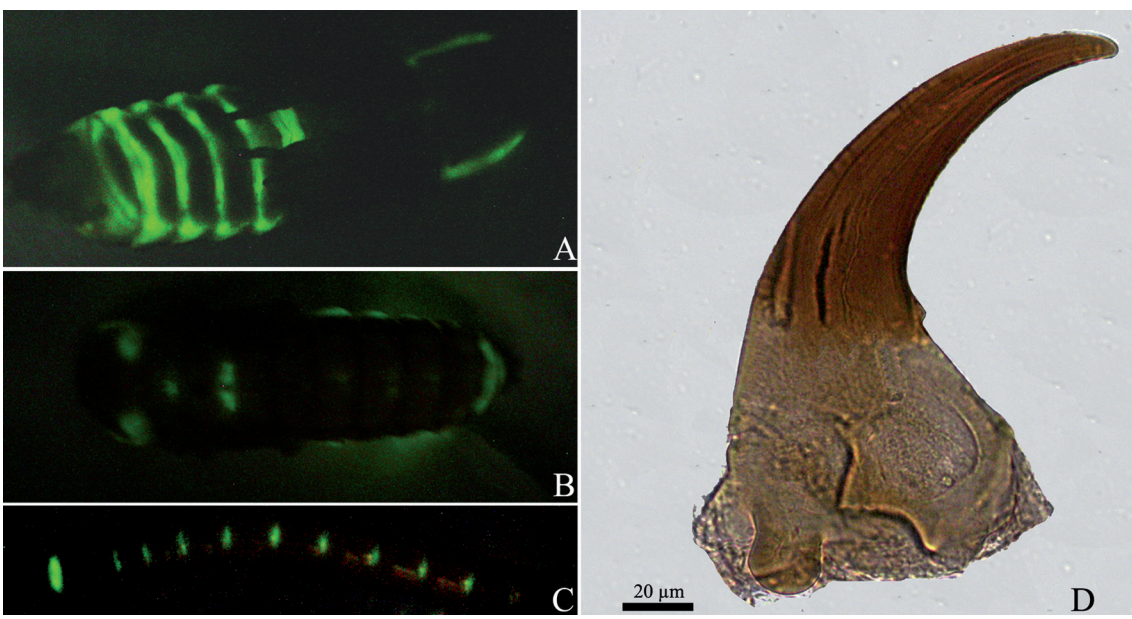

FIGURE 3: *Fulgeochlizus bruchi.* Bioluminescent patterns. **A, B,** pupa (ventral, dorsal); **C,** mature larva (dorsal). First instar larva. **D,** ventral mandible (setae and penicillum not visible).

spiniform setae lateroventrally, covered by fine setae, short and sparse dorsally, long and dense ventrally; pretarsus slender, longer than tibia with two setae lying side by side on a small ventral basal tubercle.

Abdomen: Sterna I-VIII with a pair of lateral longitudinal depressions, with 2-4 minuscule and short setae on the anterior corner, and one or two short setae lateromedially. Each laterodorsal side of terga I-VIII (Fig. 1A) with an elongate longitudinal row of setae adjacent to the spiracle and to a longitudinal depression, a few setae near the anterior margin and near the posterior margin; 1-3 sublateral setae posteriorly. Segment IX (Figs. 1M, 1N) 1.6-1.7 longer than VIII, marginated by spiniform tubercles that increase in size posteriorly, dorsal median surface with several smaller tubercles; posterior margin notched at the middle part; lateroventral to laterodorsal borders densely pilose with long setae. Segment X (Fig. 1N) ventral with a pair of lateral spines, densely pilose lateroposteriorly with short setae.

Pupa (Figs. 1B, 1C, 1L): Length 53.0 mm; adecticous and exarate, body smooth, cream-white. Head covered with pronotum in dorsal view; eyes inserted into prothorax; mouthparts visible in ventral view; labrum (Fig. 1L) with a fine stout setae on lateral margins and on anterior corners and two tubercles densely covered with spiniform setae. Pronotum with three pairs of shallow depressions, three pairs of curved processes: on the anterior margin, on the posterior margin and on the posterior angle. Pterothecae extending up to the second abdominal segment. Lateral gin-traps present on abdominal segments II-VII; tergite IX with a pair of curved apically urogomphi; spiracles I-VII in the pleural membrane visible from dorsal view.

Natural History: Two larvae reached the pupal stage under laboratory conditions. The first pupa emerged 4 years and 11 months after the eggs had hatched and the second pupa after 6 years. The first pupa took 23 days to reach the adult stage and the second was killed and fixed two days after pupation.

It was observed that a same larva could emit or not different patterns of bioluminescence, on several occasions usually after being prodded. The larvae frequently emitted bioluminescence only in a transverse strip on the anterior region of pronotum and lateroventrally on the propleurae. Another pattern observed presented light on prothorax and a shorter transverse strip on posterior region of abdominal terga I-VIII. One mature larva (Fig. 3C) emitted bright bioluminescence on all terga from pronotum to abdominal segment VII.

We also studied the bioluminescent pattern of two pupae. The first pupa revealed a longitudinal strip of light along the entire lateral margin of propleurae, strips of light along the posterior and lateral margins of abdominal segments I-IV, brighter on median region; on the dorsal face: along the pronotal margin and a median spot of light on the mesoscutellum and on all abdominal terga. Twenty days after this pupa had exhibited luminescence (Fig. 3A) on lateral margins of propleurae and pronotum, on a pair of two spots near the hind angles; on lateral and posterior margins of all abdominal segments ventrally, the light being weaker on segments VI and VII and brighter on segment I; on the dorsal face (Fig. 3B) a light spot on the mesoscutellum, two median transverse light spots on the posterior margin of metathoracic terga and on abdominal segments VII and VIII. The second pupa emitted light on the ventral face similar to that of the first pupa, but on the ventral face the luminescence was noticed in all abdominal segments since the first day.

The newly emerged teneral female emitted bright bioluminescence on a pair of elliptical spots on the corner of hind angles (Fig. 1D), along the lateral margins of hypomera and on abdominal pleurae. After 12 days only one of the two elliptical spots glowed partly while the lateral strips of the pleurae and hypomera shone continuously. After 14 days the adult stopped emitting light on the prothorax and pleurae, but kept the abdominal bioluminescent organ glowing until the 51st day, when it was fixed.

The completely pigmented adult did not emit light on the prothorax. However, a pair of yellow subcircular spots on the posterior corner of hind angles and a longitudinal yellow strip on lateral margin of hypomera remained at the same position as the teneral prothoracic luminous areas. The abdominal bioluminescent organ was well developed and occupied the entire ventral area of the first abdominal sternite.

RESUMO

Larva madura e pupa de Fulgeochlizus bruchi *(Candèze, 1896) são descritas e ilustradas. Padrões de bioluminescência observados em laboratório são descritos. Comentários e novos dados sobre a larva de primeiro ínstar e de história natural são apresentados. As larvas de primeiro ínstar diferem das larvas maduras principalmente por sua quetotaxia, que é mais esparsa e mais simetricamente distribuída.*

PALAVRAS-CHAVE: Agrypninae; Bioluminescência; Larva; Morfologia; Pupa; Região Neotropical.

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