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DESCRIPTION OF THE LARVA OF *ALAMPOIDES ALYCHNUS* (KIRSCH, 1873), THE FIRST KNOWN SPECIES WITH BIOLUMINESCENT IMMATURES IN EUPLINTHINI (ELATERIDAE, AGRYPNINAE)

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ABSTRACT

Mature larva of Alampoides alychnus (Kirsch) is described and compared to known Pyrophorini immatures. Larvae were collected live in the soil of a region dominated by sugarcane plantation and gallery forest in Campo Novo dos Parecis, Mato Grosso, Brazil. They were maintained in laboratory and the pupal period lasted 14 days. This larva differs from other Pyrophorini larvae mainly by bioluminescent pattern: one pair of luminous spots on the mesonotum, and a longitudinal series of median spots on the metanotum and all abdominal segments. The morphology of larva and the bioluminescent pattern of larva and pupa are described for the first time to the genus and the tribe. The fact that adults show no trace of luminescence is emphasized.

KEY-WORDS: Coleoptera; Immatures; Bioluminescence; Click Beetles; Firefly; Neotropical Region.

INTRODUCTION

During a scientific field trip to Campo Novo dos Parecis, Mato Grosso, Brazil (13°36'33,8"S, 57°52'9,5"W) from July 25 to August 04, 2008, S.P. Rosa collected two elaterid larvae. They were found in the soil at an altitude of 528 m between a region of sugarcane plantation and the gallery forest of the Membeça River. At first, since the larvae emitted bioluminescence, we identified them as members of Pyrophorini. This elaterid tribe comprises species that share a pair of bioluminescent organs on the pronotum as adults; all known larvae also emit bioluminescence. Therefore, it was surprising to see that

the newborn adult, identified as *Alampoides alychnus* (Kirsch, 1873), did not present bioluminescence at all or even a vestigial trait of luminous organs.

Alampoides (Kirsch) was originally described by Schwarz in 1902 (type-species *Pyrophorus submaculatus* Schwarz, 1902; Hyslop's designation, 1921). The genus has five known species, which occur in Colombia, Ecuador, Peru, Bolivia and Brazil (Amazonas, Pará and Mato Grosso). Adults are characterized by: bidentate mandibles, antennal segment 3 usually twice as long as 2 and borders of the mesosternal cavity slightly raised posteriorly. *Alampoides* was placed in the taxa Heligmini and Alampina (Costa 1975). Johnson (2002) replaced the name Heligmini Costa, 1975 with Cleidecostini

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because of the preoccupied genus name, not *Heligmus* Dujardin, 1845 [Nematoda] syn. of *Cleidecosta* Johnson, 2002. Bouchard *et al.* (2011) considered *Cleidecostini* as subtribe (*Cleidecostina*) of *Euplinthini*.

MATERIAL AND METHODS

All specimens studied are deposited in the Coleoptera Immature Collection of the Museu de Zoologia, Universidade de São Paulo (MZSP).

The larvae were reared in the laboratory in small plastic boxes containing soil and kept at 26°C in a "Germination Camera Fanem mod. 347". They were fed weekly with termite workers. One larva pupated on October 5, 2009 and the adult emerged 14 days later. The second larva died before pupation.

The larval exuviae were dissected in alcohol under a stereomicroscope. Temporary slides were produced using Hoyer's medium. Pictures and video were taken with a Canon PowerShot A640 camera, and luminescence patterns could be seen in both the light and dark. Drawings were made with a Zeiss Stemi SV6 coupled to a camera lucida. Drawings of the larval habitus were rendered according to photos.

RESULTS

Description of mature larva (Fig. 1)

Length: 26 mm. Body (Fig. 1A) elongate, parallel-sided, flattened. Dorsal and ventral face yellowish, except for brown pronotum and legs; head dark brown.

Head prognathous, depressed, each side of dorsal surface (Fig. 1B) with two dorsal setae posteriorly to antenna; a row of lateral setae in a longitudinal depression; one long and several smaller setae scattered between frons and lateral borders and a longitudinal row of three setae dorsoposteriorly. Posterior margin emarginate. Epicranial stem absent. Frontal arms (Fig. 1B) lyriform; a single stemma on each side near base of mandibles. Nasal (Fig. 1C) with three teeth, adnasalia as long as nasal with at least two setae (punctures indicating 5-6 setae). Antennae (Figs. 1G, 1H) densely setose, elongate, 3-segmented; apical antennomere very short with two long thick setae apically; antennomere II with a conical sensorium, with several short and longer setae widespread dorsal and ventrally and a long thick seta dorsolaterally; antennomere I with a row of long setae along the apical border and a few widespread setae basally. Mandibles (Figs. 1E, 1F) wide at

base and tapering to apex; unidentate; mesal surface of mandibular base with a small penicillus; ventrolateral margin with one seta; dorsomedian surface with one seta. Hypocephalic carina with a row of eight setae, almost reaching the posterior margin of head. Ventral mouthparts forming maxillolabial complex (Fig. 1D); maxillae with cardines triangular, narrow and elongate, contiguous to each other at midline; stipites elongate scarcely pilose along lateral border; galea 2-segmented with short spiniform setae apically; palp 4-segmented, setose. Postmentum triangular, widened anteriorly with a row of 4 setae laterally and a pair of setae at apex; prementum with a transverse row of setae, ligula short and rounded apically; labial palps 2-segmented, widely separate, apical segment with two basal microsetae and several micro sensoria apically.

Thorax (Fig. 1A): Prothorax 0.76 as long as meso- and metathorax combined; metathorax 1.2 longer than mesothorax. Pronotum with several setae laterally. Meso- and metanotum densely pilose near lateral margin, with 1-3 pairs of setae dorsally. Mesothoracic spiracle lateroventrally located. Legs (Fig. 1I) stout with trochanter; femur and tibia with ventral spiniform setae, lateral borders with a few finer and shorter setae; pretarsus slender, longer than tibia with two setae lying side by side.

Abdomen (Fig. 1A): Each laterodorsal side of terga I-VIII with an elongate longitudinal row of setae adjacent to the spiracle and to a longitudinal depression, a setae on anterior margin and a pair of setae on posterior margin; Segment IX (Fig. 1J) 1.2-1.4 longer than VIII, marginated by four spiniform tubercles that increase in size posteriorly, dorsal median surface with several setae and smaller tubercles, posterior margin notched at middle forming a bifurcate urogomphi, each part with two pilose spines apically; lateroventral and laterodorsal borders densely pilose with long setae. Segment X ventral, with a pair of lateral spines, with 2-3 transversal rows of setae anteriorly and a longitudinal lateral row of pilose tubercles.

Material examined: BRAZIL. Mato Grosso. Campo Novo dos Parecis (13°36'33,8"S, 57°52'9,5"W, 528 m high), 25-VII-04-VIII. 2008, S.P. Rosa, S.A. Casari, G. Ide, L. Prado cols. 1 larva reared to adult and 1 dead larva, fixed in alcohol.

Biological notes

In the laboratory from August 2008 to October 2009, before the pupa and adult had emerged,

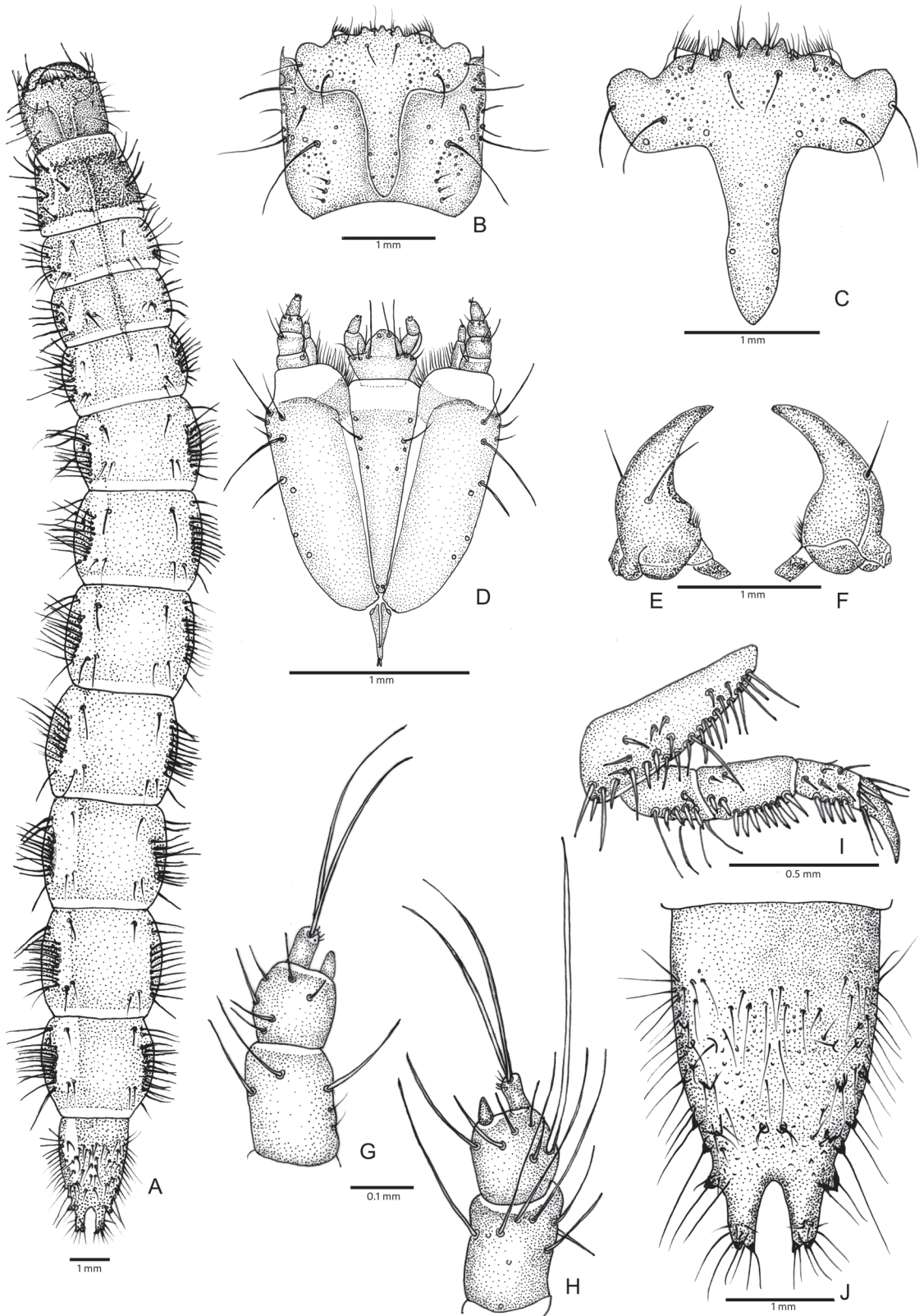


FIGURE 1: Mature larva of *Alampoides alychnus* (Kirsh): (A) dorsal habitus; (B) dorsal head; (C) nasal; (D) maxillolabial complex; (E, F) mandibula (dorsal, ventral); (G, H) antenna (ventral, dorsal); (I) posterior leg; (J) tergum IX.

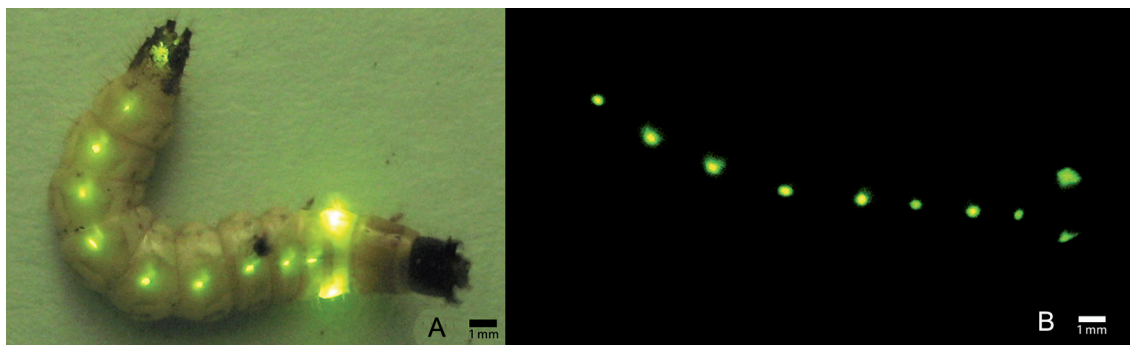


FIGURE 2: Bioluminescence on larva of *Alampoides alychnus* (Kirsh): (A) position of the luminescent organs; (B) size of luminescent organs.

the larva had undergone three ecdyses. The first molt occurred about a month after being collected in the field, the second after about three months, and the third seven months later. The pupal period lasted 14 days. The second larva survived until February 08, 2010 and died while undergoing the first ecdysis in the laboratory. Both larvae showed bioluminescence in one pair of luminous spots on the mesonotum (Fig. 2), as well as a longitudinal series of median spots on the metanotum and all abdominal segments. The mesothoracic spots were larger and brighter than the metathoracic and abdominal luminous organs. Luminescence was green in color (naked eye observation). The larvae emitted a single glow by the thoracic and last abdominal organs or by the thoracic and all abdominal organs concomitantly. Luminescence became brighter when the larvae were disturbed as shown in video 1 provided in supplementary material. After the larvae had been disturbed, light intensity decreased slowly. The duration of the glow lasted 8-16 seconds. The same spots on the larva were illuminated on the pupa (Fig. 3) and a diffuse glow also occurred over the entire body. The newborn adult (Fig. 4) did not present any diffuse light or bioluminescent organs.

DISCUSSION

The larval bioluminescent pattern of *Alampoides alychnus* (Kirsh) differs from the luminescent patterns presented by the Pyrophorini species (Costa, 1970; Casari-Chen & Costa, 1986, Rosa *et al.* 2010), especially in the absence of luminescent spots on the prothorax (Fig. 2A). The median luminescent spots of metanotum and abdominal segments are similar to those of *Pyrearinus janus* (Herbst, 1906), although the latter has an additional pair of lateral spots.

Larva and pupa of *Alampoides alychnus* (Kirsh) resemble those of the Pyrophorini. The larva is

morphologically similar to the well-known *Pyrophorus* larvae due to its mandible with two setae, abdominal terga 1-8 with one anterior and two posterior pairs of setae, and because of its abdominal tergum 9 with four pairs of tubercles forming two lateral rows anteriorly to the bifurcate urogomphi. The antenna has two AS3 as in *Pyrophorus divergens* Eschscholtz, 1829.

Alampoides alychnus is the first known species of Euplinthini that presents bioluminescence. It is also noteworthy that the adult does not exhibit any trace of bioluminescence. Species with bioluminescence only in immature stages are known in Lampyridae (Branham, 2010) and Phengodidae (Costa & Zaragoza, 2010), but in Elateridae the adults of all bioluminescent species of Pyrophorini (Agrypninae) and Thylacosterninae present yellow spots on the pronotum, which are presumably luminescent organs.

Crowson (1981) stated, "In any taxon where bioluminescence is a stable characteristic, it almost certainly serves some adaptive function. In support of an aposematic function of larval lights is the fact that these lights are only turned on when the larva is molested in some way". Additionally, Crowson in a letter to C. Costa (24-3-1994) suggested "that luminosity in Coleoptera tends to develop first in the larval stage, as an aposematic marker, and then maybe carries over into the adults where it acquires new functions". Branham & Wenzel (2003) in a phylogenetic analysis of cantharoid beetles suggested that "luminescence arose first in the larvae and then subsequently in the adults".

The aposematic function of the larval bioluminescence is supported by the increase of light intensity observed in larvae of Pyrophorini as well as in the larvae of *Alampoides alychnus* studied in the present work. Nevertheless, the phylogenetic relationships between *A. alychnus* and Pyrophorini species are unknown and do not allow us to infer the origin of bioluminescence in those species.

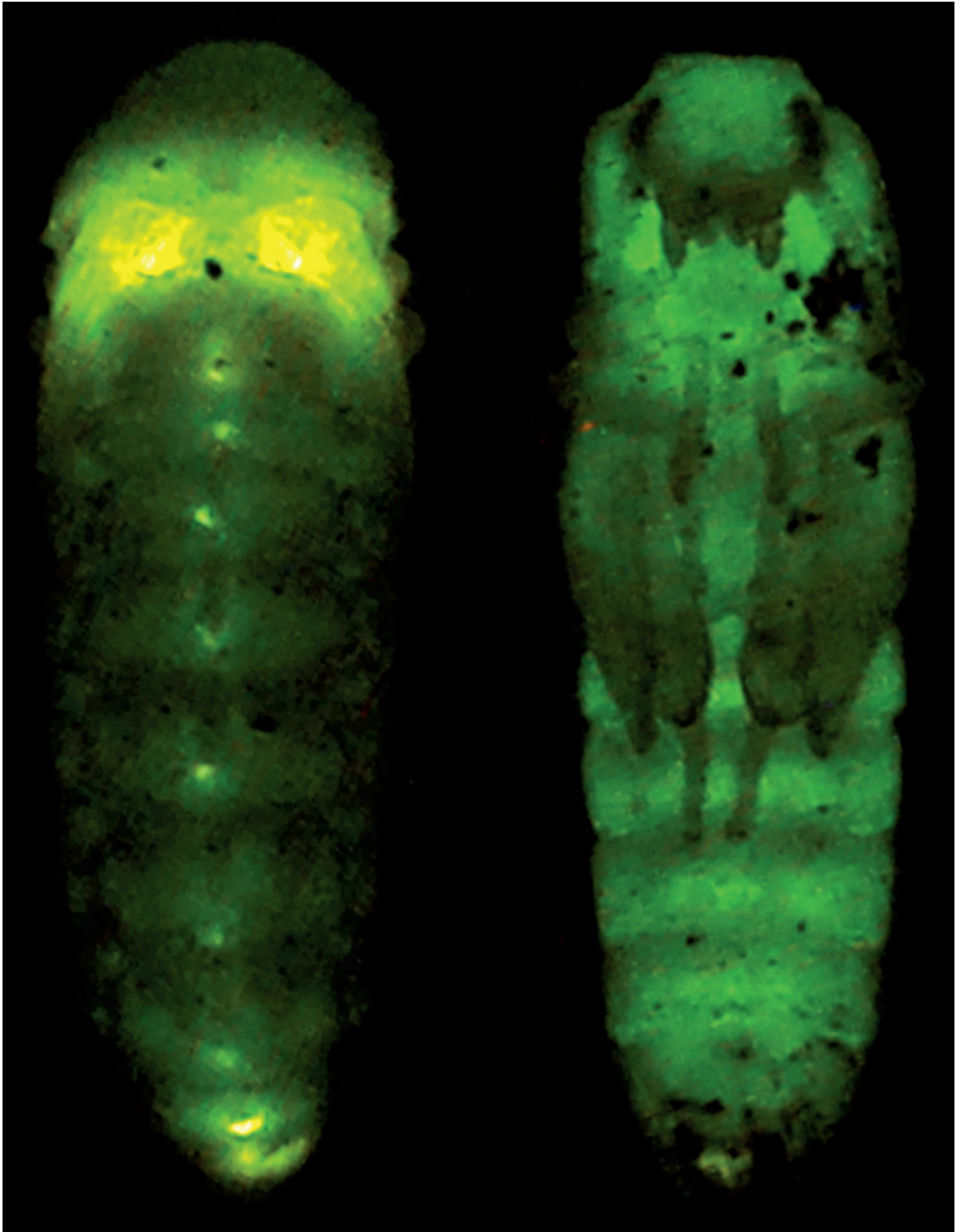


FIGURE 3: Bioluminescence on pupa of *Alampoides alychnus* (Kirsh): (A) dorsal; (B) ventral.

CONCLUSION

The similarities and the presence of bioluminescence in *Alampoides alychnus* (Kirsh) suggest a close

phylogenetic relationship between Pyrophorini and Euplinthini. The results presented here highlight the importance of the study of immatures to the phylogeny and biology of luminescent elaterids. A cladistic



FIGURE 4: Male adult of *Alampoides alychnus* (Kirsh).

analysis including those data should clarify the relationships between the tribes, and contribute to the understanding of the origin of bioluminescence in Elateridae.

RESUMO

A larva de *Alampoides alychnus* (Kirsch) é descrita e comparada às larvas bioluminescentes de espécies de Pyrophorini. Larvas foram coletadas vivas no solo, entre uma plantação de cana-de-açúcar e mata ciliar localizada em Campo Novo dos Parecís, Mato Grosso, Brasil. Foram mantidas em laboratório. Uma larva atingiu o estágio pupal e após 14 dias o estágio adulto. Estas larvas diferem das larvas de Pyrophorini principalmente pelo padrão de bioluminescência: um par de órgãos luminescentes no mesonoto e uma série de órgãos luminescentes medianos no metanoto e no abdômen. A morfologia da larva e o padrão bioluminescente da larva e da pupa são descritos pela primeira vez para o gênero e para a tribo. O adulto não apresentou luminescência ou vestígio de órgão luminescente.

PALAVRAS-CHAVE: Coleoptera; Imaturos; Bioluminescência; Vagalume; Região neotropical.

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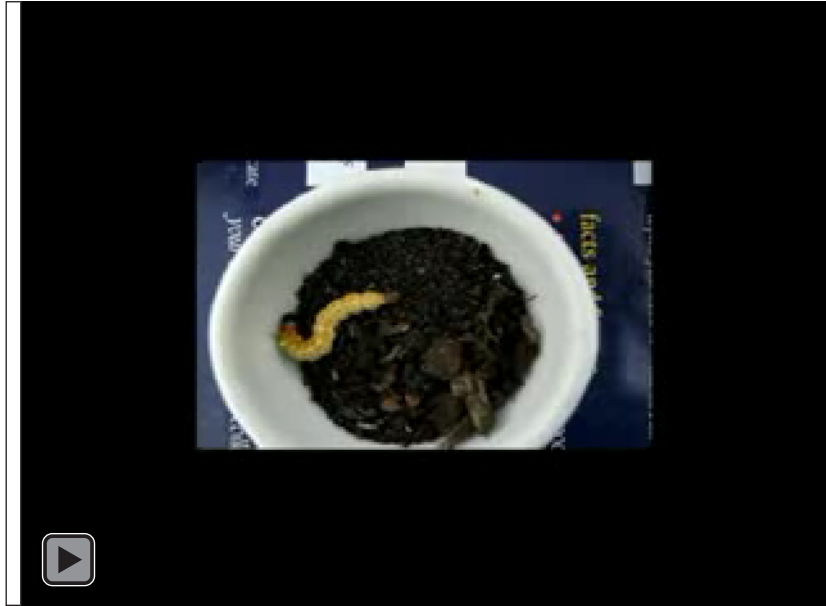


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SUPPLEMENTARY MATERIAL

Video 1: *Alampoides alychnus*. Larva glowing after being disturbed.

Link to video: www.scielo.br/scielo.php?script=sci_issuetoc&pid=0031-1049201300##&lng=en&nrm=iso



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