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Taxonomy and Systematic

A new species of Aididae (Lepidoptera, Zygaenoidea) and the first record of the family for the Northern Region of Brazil

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Abstract. A new species of Aididae is described and illustrated based on adults (male and female) and immature (last instar larvae). The larvae were found infesting leaves of *Inga edulis* Martius (Fabaceae) in the municipality of Autazes, State of Amazonas, representing the first record of Aididae in the northern region of Brazil. The new species is further compared with its closest species, *Aidos amanda* (Stoll, 1782).

Keywords: *Aidos*; caterpillars; immature stages; *Inga edulis*; taxonomy.

Aididae is a small group of Lepidoptera exclusive to the Neotropical region (Epstein 1996; Chacón & Montero 2007). Currently, the family consists of two genera and six species: *Aidos*, proposed by Hübner (1820), composed of *Aidos amanda* (Stoll, 1782) *Aidos perfusa* (Schaus, 1905) and *Aidos yamouna* (Dognin, 1891); and *Brachycodilla*, proposed by Dyar (1898), composed of *Brachycodilla admirabilis* (Schaus, 1894), *Brachycodilla carmen* (Schaus, 1892) and *Brachycodilla osorius* (Herrich-Schäffer, [1856]). This systematic arrangement, proposed by Becker (1995), also includes five subspecies *Aidos perfusa perfusa* (Schaus, 1905), *Aidos perfusa admiranda* Schaus, 1912, *Aidos yamouna yamouna* Dognin, 1891, *Aidos yamouna cynosura* Dognin, 1911 and *Aidos yamouna nuncilla* Dognin, 1914.

Initially, the genera and species were inserted in Limacodidae or in Megalopygidae, later grouped in a subfamily, Aidinae (Dyar 1895), and Forbes (1923) considered it as a family. Other authors also treated the group as a subfamily (e.g., Becker 1995; Scoble 1995; Heppner 2003). Epstein (1996), in a phylogenetic analysis, concluded that it is an independent family, a sister group of Limacodidae and Dalceridae. These families, together with Megalopygidae and Somabrachyidae, are part of the "Limacodidae Group", a monophyletic group belonging to the Zygaenoidea superfamily (Epstein 1996; Epstein *et al*. 1999).

Aididae is restricted to Central and South America, with records for Costa Rica, French Guiana, Venezuela, Suriname, Ecuador, Colombia and Brazil (Epstein 1995; Becker 1995; Chacón & Montero 2007). In Brazil, there are records for South, Southeast and Midwest regions (Specht *et al*. 2005; Siewert & Silva 2012; Diniz *et al*. 2013). According to the *Taxonomic Catalog of Fauna of Brazil* (Casagrande *et al*. 2019), only four species of Aididae have been registered for Brazil: *A. amanda, B. admirabilis, B. carmem* and *B. osorius*. Duarte *et al*. (2012), on the other hand, had mentioned that only *A. yamouna* does not have a record for Brazil.

Studies regarding the biology of these lepidopterans are scarce, only the immatures of *A. amanda* are known, except the eggs (Epstein 1995; Duarte *et al*. 2012; Diniz *et al*. 2013). As host plants, *Sclerobium paniculatum* Vogel (Fabaceae) and *Caryocar brasiliense* Cambess (Caryocaraceae) have been reported by Diniz *et al*. (2013); and *Annona punicifolia* Triana & Planch. (Annonaceae) by Epstein (1995).

In 2007, in the municipality of Autazes, state of Amazonas, Aididae caterpillars were found feeding on the leaves of *Inga edulis* Martius (Fabaceae). The specimens were collected and taken for breeding in the laboratory at Instituto Nacional de Pesquisas da Amazônia - INPA. On that occasion, the adults that emerged were identified as *A. amanda* and deposited to the Invertebrate collection of INPA.

Recently, while surveying the groups of lepidopterans in the INPA collection, I found the specimens stored as miscellaneous. Then, I analyzed the morphology of the immatures and the records regarding the behavior of the pupae, and I found that they differ from those of *A. amanda* described by Epstein (1995, 1997) and Diniz *et al*. (2013). Such differences raised doubts about the correct identification of these specimens. Thus, an exhaustive search for *A. amanda* type material was carried out, but it was not found. However, based on the characteristics of the immatures and the distribution, I consider that the specimens of Autazes, in fact,

correspond to a new species of Aididae, similar to *A. amanda*.

Thus, the purpose of this work is to describe and illustrate adults and larva of the new species, thereby expanding the knowledge about the taxon. In addition, this work also represents the first record of this family for the northern region of Brazil.

MATERIAL AND METHODS

The specimens, adults (23 females and eight males) and immature (2 last instar larvae) are deposited in the collection of Invertebrates of the "Instituto Nacional de Pesquisas da Amazônia" - INPA, under the registration numbers 72469 to 72499.

The comparisons with the other species of Aididae was made based on the morphological characters description and images presented in Stoll (1782), Epstein (1995, 1996, 1997), Chacón & Montero (2007) and Diniz *et al.* (2013) and yet, with scarce information.

The specimens were photographed and the right forewing of the specimens (all females and four males) were measured with a digital caliper. Four males and three female specimens had their abdomens removed and cleared in 10% potassium hydroxide (KOH) solution for further dissection and removal of the genitalia, which was analyzed and photographed with digital camera Leica® M205A stereomicroscope coupled with a Leica® DMC4500 and a Leica Application Suite v. 4.10.0 Interactive Measurements Montage. The left valve was removed and photographed separately. The aedeagus was illustrated along with other structures of the genitalia, due to the difficulty of its removal. After analysis, the structures were stored in microtubes containing glycerin, with corresponding specimen number and attached to them.

RESULTS

Aidos alencari Lourido sp. n. (Figures 1-2)

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Diagnosis. Adult female and male with discal cells shown in the forewings, abdomen dorsally red with narrow median light brown band in segments I and II, brown in segments III to VII and yellowish white in segment VIII. Female genitalia with papillae analis dorsal portion partially fused medially, dorsal lobes with rounded ends; posterior apophyses with slightly curved anterior end; in ventral view, ostium bursae digitiform; ductus bursae twice longer than the corpus bursae, slightly sclerotized in the ventral portion of the posterior third; corpus bursae oval; ductus seminalis relatively long; spermatheca small and oval. Last instar larvae with general orange coloration; verruca with groups of 9 to 13 black setae, distributed in two dorsal rows, in the thoracic T3 and abdominal segments from A1 to A8, and two subdorsal, in the segments from A2 to A7.

Description

Adults (Figures 1A-D, 2A-F).

Female. (Figures 1A-B, 2A-B). Forewing length from external lateral edge of thorax to apex, holotype: 25.3 mm; paratypes: 24.10 to 27.6 mm (n=22).

Head: Filiform antennae, with 42 flagelomeres, provided with dark brown scales; flagella with dark brown scales interspersed with white scales on the apical two thirds. Vertex dark brown; sub quadrangular frontoclypeus, yellowish white. Glabrous compound eyes, with rectilinear inner margin. Paired chaetosema, represented by two small areas of differentiated setae, arranged laterally after the antennal alveolus. Labial palpus with two segments; basal article shorter than the distal, and covered with dark brown scales and a narrow white transverse band on the distal margin; dark brown distal article.

Thorax: Prothorax with a complete dark brown transverse stripe; meso and metanota coated with light brown scales; subtriangular tegules, interspersed with white scales; ventral surface of the meso and meta-sternum white. Subtriangular forewings with slightly concave outer margin; dorsal surface covered with white scales interspersed with light brown scales, concentrated along the costal margin, grouped, and forming transversal bands between M_2 and CuA_1 and along the inner margin; frenulum formed by a group of developed bristles; retinaculum absent. Hindwings with a slightly sinuous tornus, reddish in the basal half and light brown in the distal. Wing coupling structure consist of a tuft of bristles (five to six), and retinaculum absent. Pro-, meso- and meta-thoracic legs of subequal lengths, predominantly white, with tibia and tarsi interspersed with light brown scales.

Abdomen: with a coppery red dorsal surface, with golden scales in the median region of each tergum; golden ventral face.

Female genitalia: Sternum VII with conspicuous fold on the ostium bursae. Papillae analis divided equally into dorsal and ventral lobes, both with rounded ends; dorsal portion partially fused medially. Anterior and posterior apophyses elongated and of subequal lengths; posterior apophyses with slightly curved anterior end. Antevaginal lamella formed by a transversal plate, bordering the ostium. In ventral view, ostium bursae digitiform. Ductus bursae expanded in the middle third, twice longer than the corpus bursae, membranous, slightly sclerotized in the ventral portion of the posterior third. Corpus bursae oval, membranous; signa absent. Ductus seminalis relatively long, arising dorsally in the distal third of the ductus bursae. Spermatheca small and oval. Sebaceous gland elongated and forked, connected to oviduct. Accessory gland occupying a large part of segments A7 to A8.

Male. (Figures 1C-D, 2C-F). Length of forewing from external lateral edge of thorax to apex, paratypes: 17.6 to 20.7 mm (n=4).

Head: Antennas with pedicel composed of 48 flagelomeres, bipectinate between the 1st to the 20th, and indented from the 21st. Vertex with black scales; frontoclypeus with black scales with narrow cross-section of dark brown scales. Labial palpus with second article, dark brown basal half and black distal.

Thorax: Frenulum formed by a set of elongated and fused bristles, retinaculum present.

Abdomen: Coppery red dorsal surface, with golden scales in the midlongitudinal region of each tergum; golden ventral face.

Male genitalia: Uncus dorso-ventrally curved, longer than wide, pointed at apex, with projection anterior to the apex of the valva, dorsally bristly. Tegumen semi trapezoidal, in dorsal view, proximal margin with V-indentation, delimitation with the uncus evident in the median region. Gnathos absent. Inferior fultura bilobed, claw-shaped posterior end. Vinculum more than one-half width of tegumen. Saccus reduced. Valva symmetrical, twice longer than uncus, sub-elliptical, densely bristle internal surface. Aedeagus cylindrical, sclerotized, slightly curved; vesica membranous. Tuba analis developed and with sclerotization in the ventral

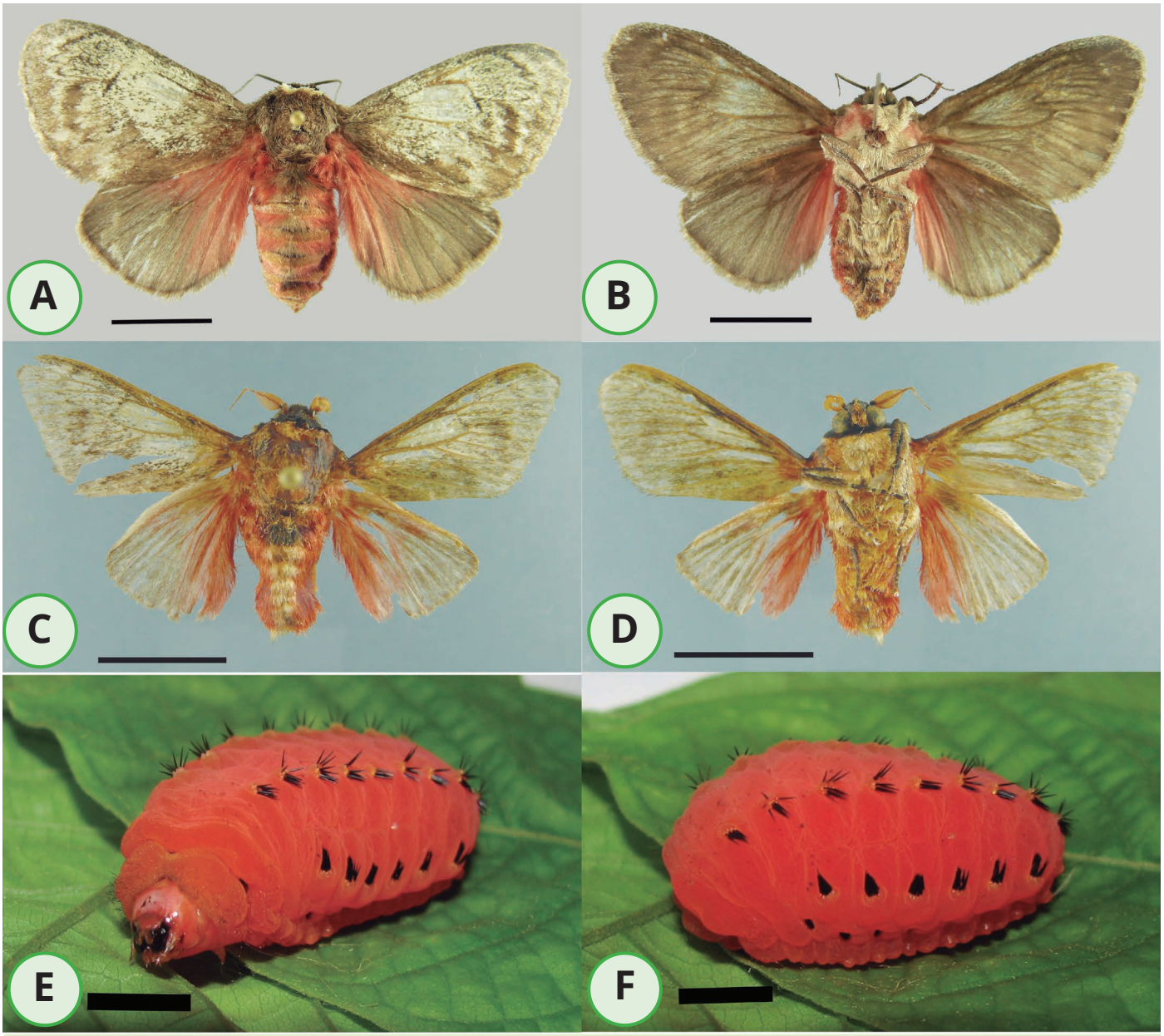

Figure 1. *Aidos alencari* **sp. n.** A-B. Dorsal and ventral views of the female, respectively. C-D. Dorsal and ventral views of male, respectively. E-F. Larvae on leaves of *Inga edulis* Martius. Scale = 10 mm.

portion, the subscaphium, with anterior portion rough, and posterior smooth.

Larvae of last instar (Figures 1E-F):
Length 23 mm and 22 mm (n=2).

Stout body, general orange coloration with pink spots arranged longitudinally or distributed irregularly in the dorsal region. Orange, smooth, shiny head capsule; antennae with three segments, disposed near the base of the mandibles; six pairs of stemmata; enclosed area of stemmata black; labrum with stout setae on the anterior surface; spinneret tubular; mandibles well sclerotized, entirely black. Black ellipsoid spiracles, present in prothorax (T1) and in segments A1 to A8 of the abdomen. Short secondary setae sparse, more numerous in T1; verruca with thick, black urticating setae, with yellow basal area with groups of nine to 13 black setae, distributed in two dorsal rows, in the thoracic T3 and abdominal segments from A1 to A8, and two subdorsal, in the segments from A2 to A7. Setae are retracted when at rest and arranged in a rosette when the caterpillar is disturbed. Abdominal prolegs with crochets present from A2 to A7 and in A10.

Pupae. protected in cocoons, have a gregarious habit in the laboratory. The cocoons were unopened and the remaining exuviae were not found in the collection of INPA, thus making it impossible to describe the pupa.

Bionomy: All larvae were collected in September 2007, infesting leaves of *Inga edulis* Martius (Fabaceae). The collected specimens correspond to last-instar larvae, which pupated four to five days after collection. The pupation period lasted from 35 to 40 days. After emergence, adults had a longevity of two to three days.

Geographical distribution: Known from a single locality in the northern region of Brazil, Autazes municipality in the state of Amazonas. The collection area corresponds to a private property, located at Km 06 of AZ2 (Estrada do Sampaio), municipality of Autazes, state of Amazonas (3°38' S;18°30' W).

Etymology: The specific epithet is a tribute to Mr. Raimundo Botelho de Alencar, owner of the area where the specimens of *A. alencari* **sp. n.**, for his helpful hospitality and help during collection, *in memoriam*.

Type material: Holotype Female: BRASIL, *Amazonas*, Autazes/ Estrada AZ-2, km 6/ 03°38' S; 18°30 W/ 16.ix.2007, G.M. Lourido; R.B. Alencar; V.R. Alves *col.*/Larva coletada em *Inga edulis* Mart. (Fabaceae)/ Ex. Pupa: 06.xi.2007, 0072478.

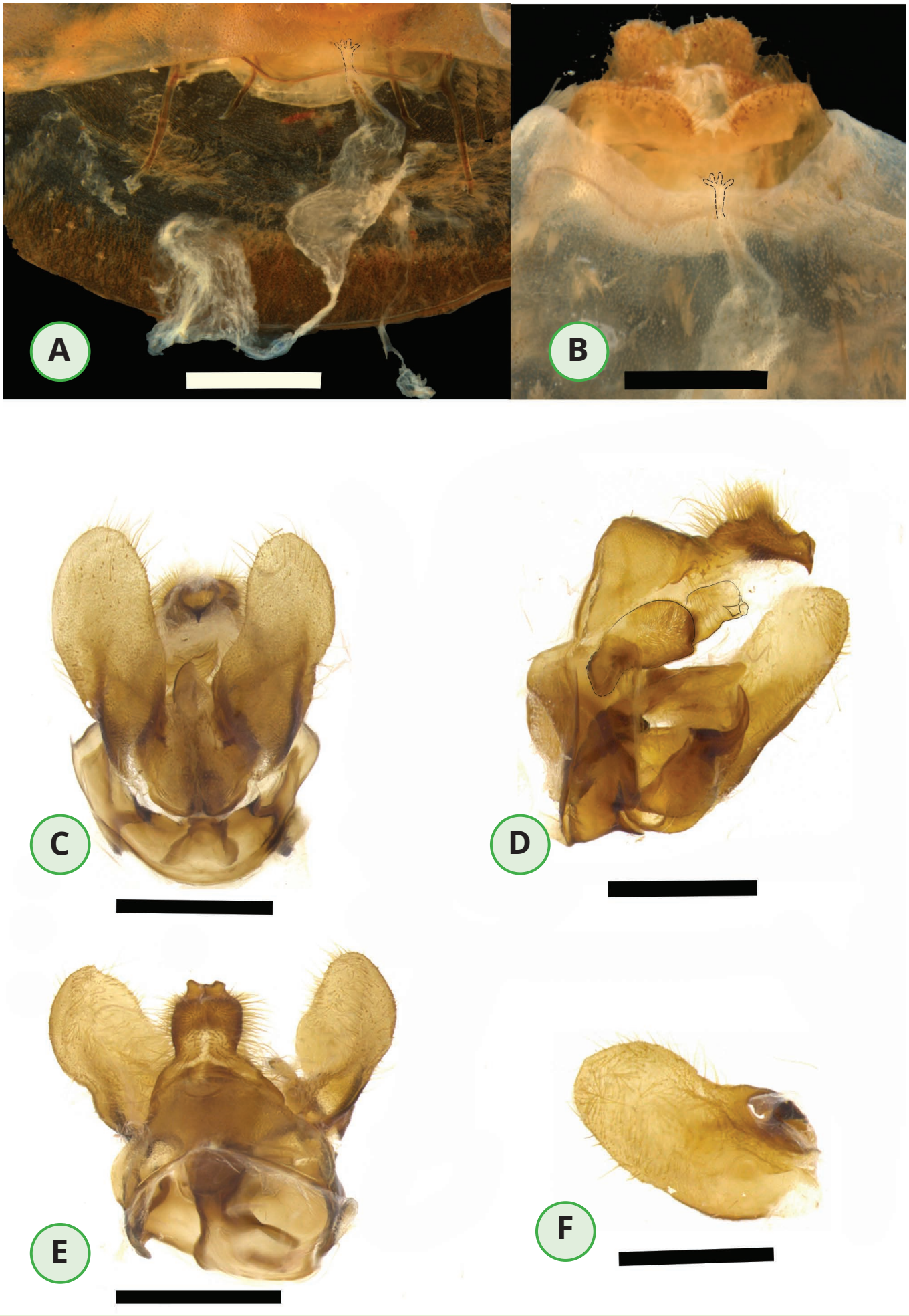

Figure 2. *Aidos alencari* **sp. n.** A-B Distal portion of female genitalia in ventral view. A - Ductus bursae, corpus bursae and spermatheca details. B- Papillae analis. C-F Male genitalia with left valve removed. C. Ventral view. D. Lateral view. E. Dorsal view. F. left valve. Scales = 1 mm (A-E) and 0.5 mm (F)

Paratypes: 30 adults (22 females and eight males) and **two last instar larvae**, same label data as holotype, except: Ex. Pupa: 05.xi.2007, 0072475, one Male; idem, Ex. Pupa: 06.xi.2007, 0072497, one Female; idem, 0072480 one Female; idem, 0072477 one Female; idem, 0072485, one Female; idem, 0072486, one Female; idem, 0072479, one Female; idem, 0072496, one Female; idem, Ex. Pupa: 07.xi.2007, 0072490, one Female; idem, 0072484, one Female; idem, 0072488, one Female; idem, 0072493, one Female; idem, 0072494, one Female; idem, 0072498, one Female; idem, 0072471, one Male; idem, 0072470, one Male; idem, Ex. Pupa: 09.xi.2007, 0072481, one Female; idem, 0072482 one Female; idem, Ex. Pupa: 10.xi.2007/ 0072499, one Female; idem, 0072483 one Female; idem, 0072487, one Female; idem, 0072489, one Female; idem, 0072492, one Female; idem, 0072495, one Female; idem, [S/N]; 0072476, one Male; 0072473, one Male; idem, 0072474, one Male; idem, Ex. Pupa: 11.xi.2007, 0072491, one Female; idem, Ex. Pupa: 27.xi.2007/ 0072469, 1 Male; idem [S/D], 0072472, one Male. Deposited at INPA.

DISCUSSION

Information about Aididae is scarce and inaccurate. General biological aspects and morphology of adults and immatures are addressed in Dyar (1895), Epstein (1995, 1996, 1997) and Epstein *et al*. (1999), other studies have recorded or mentioned the occurrence of species in surveys (e.g., Specht *et al*. 2005; Diniz *et al*. 2013).

No descriptions and/or illustrations of the genitalia of all species were found in the literature. Epstein (1995, 1996), in his phylogenetic analysis and review of the families of the Limacodidae group, illustrated the male genitalia of *B. carmem* and the female genitalia of *A. amanda*. However, the latter's illustration makes it possible to differentiate it precisely from *A. alencari* **sp. n**., mainly due to the shape and length of the ductus bursae, corpus bursae and ductus seminalis. Ductus bursae twice longer than the corpus bursae in *A. alencari* **sp. n.**, and practically of equal length in *A. Amanda.* The ventral portion of the distal third of ductus bursae of *A. alencari* **sp. n,** has sclerosis, not mentioned in *A. amanda*, probably absent. In *A. alencari* **sp. n.**, ductus seminalis is elongated, and reaches up to the median region of corpus bursae.

Epstein (1995) reported details of the biology of a specimen (larva) collected in Venezuela, assuming it was *A. amanda*. In the same work, the author provided information on the construction of cocoons and host plants. The caterpillars of *A. amanda* (Stoll 1782), according to Epstein (1995), are completely green, with verruca with 5 to 11 black and thick setae per group, in dorsal and subdorsal rows on the thorax (T3) and abdomen (A2 to A9); the stinging setae remain united and collected in a common point when at rest and are arranged obliquely forming rosettes when protruded. Diniz *et al*. (2013), carrying out a survey of species from the Brazilian Cerrado, found *A. amanda* caterpillars, solitary and with a green tegument. The caterpillars of *A. alencari* **sp. n**. is predominantly orange and pink, and verruca with groups of 9 to 13 setae, distributed in the thorax (T3) and abdominal segments from A1 to A8, differing from those of *A. amanda* described by Epstein (1995, 1996) and Diniz *et al*. (2013).

Medical importance is attributed to Aididae caterpillars as they can cause allergic reactions in humans (Specht *et al*. 2005). Such information is consistent with *A. alencari* **sp. n**. According to Corseuil *et al.* (2008), the set of bristles assembled in small elevations is called verruca, and these may be connected to hypodermal glands that produce substances capable of causing burns.

As host plants for Aididae, five botanical families are registered: Annonaceae, Fagaceae, Rubiaceae, Fabaceae and Caryocaraceae. The specimen created by Epstein (1995) would have been fed with leaves of *Annona punicifolia* (Annonaceae) and, later, *Quercus* sp. (Fagaceae). The author reports that he examined a specimen of *A. yamouna* from Peru, deposited in the collection of the National Museum of Natural History - USNM, which would have been created in *Cinchona ledgeriana* (Howard) Bern. Moens ex Trimen (Rubiaceae). Diniz *et al*. (2013) report that specimens of *A. amanda* were found and raised in leaves of *Sclerobium paniculatum* (Fabaceae) and *Caryocar brasiliense* (Caryocaraceae). *A. alencari* **sp. n.** was found in *I. edulis*, a tree species belonging to the Leguminosae family - Mimosoideae, native to Tropical America (Falcão & Clement 2000), the fruit being edible and much appreciated by the local population. In the Northern region of Brazil, *I. edulis* is found, often planted in backyards.

The tree where the larvae of *A. alencari* **sp. n**. was found, belonged to a field on dry land used for raising pasture, surrounded by secondary forest. Although, there were at least 10 *I. edulis* trees in the area, the caterpillars were found infesting only one, which was isolated from the others.

Regarding the group's distribution, the genus *Brachycodilla* is restricted to the South and Southeast regions of Brazil, with records for the states of Rio de Janeiro, Paraná and Rio Grande do Sul (Table 1). *Aidos*, on the other hand, occurs

Table 1. Geographical distribution of the Aididae, systematic arrangement proposed by Becker (1995).

Species and subspecies	Occurrence records	References
Aidos amanda (Stoll, 1782)	SURINAME (Type locality) BRAZIL, Goiás, Pirenópolis VENEZUELA COSTA RICA	Stoll 1782; Diniz *et al.* 2013; Epstein 1995, 1996; Chacón & Montero 2007
Aidos perfusa (Schaus, 1905)	FRENCH GUIANA (Type locality)	Schaus 1905; Epstein 1995
A. perfusa perfusa (Schaus, 1905)	FRENCH GUIANA	Becker 1995
A. perfusa admiranda Schaus, 1912	COSTA RICA	Chacón & Montero 2007
Aidos yamouna (Dognin,1891)	ECUADOR (Type locality); PERU	Becker 1995; Epstein 1995, 1996
A. yamouna yamouna Dognin, 1891	ECUADOR	Becker 1995
A. yamouna cynosura Dognin, 1911	COLOMBIA	Becker 1995
A. yamouna nuncilla Dognin, 1914	COLOMBIA	Becker 1995
Aidos alencari Lourido **sp. n.**	BRAZIL, Amazonas, Autazes	This work
Brachycodilla admirabilis (Schaus, 1894)	BRAZIL, Paraná, Castro (Type locality)	Schaus 1894
Brachycodilla carmen (Schaus, 1892)	BRAZIL, Rio de Janeiro (Type locality) BRAZIL, Rio Grande do Sul, Missões e Morro Redondo	Schaus 1892; Specht *et al.* 2005; Siewert & Silva 2012
Brachycodilla osorius (Herrich-Schäffer, [1856])	BRAZIL, Paraná, Castro (Type locality)	Specht *et al.* 2005

more in the north, in Costa Rica, French Guiana, Venezuela, Suriname, Ecuador, Colombia and in the Midwestern region of Brazil (Table 1). *A. amanda* has been registered for Suriname, Costa Rica, Venezuela and the Midwestern region of Brazil. Therefore, this is the first record of Aididae from the Northern Region of Brazil.

However, I believe that the species found in the Brazilian Midwest is not the same as the one described by Stoll (1782), from Suriname. Thus, a broader study including all species of Aididae is recommended, allowing a better understanding of the group.

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