

Scientific Note

New records of spider flies (Diptera: Acroceridae) in neotropical jumping spiders (Araneae: Salticidae)

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Abstract. Salticidae is the most diverse family within the order Araneae. Acroceridae are obligate parasites of spiders, since they need them to complete their development. The aim of this study is to report for the first time the presence of the species *Ogcodes argentinensis* Schlinger, 1960 (Diptera: Acroceridae: Ogcodinae) in a sub-adult individual of *Jollas leucoproctus* (Mello-Leitão, 1944) (Salticidae: Sitticini: Sitticina) and the genus *Acrocera* Meigen, 1803 (Diptera: Acroceridae) in a sub-adult of *Titanattus sciosciae* Rubio, Baigorria & Stolar, 2021 (Salticidae: Thiodinini). Both spiders were collected in two different localities from Maldonado department in Uruguay.

Keywords: Salticidae, parasitism, *Ogcodes*, *Acrocera*.

Salticidae Blackwall, 1841 are currently the most diverse family in the Araneae, with 677 genera and 6,575 species (World Spider Catalog 2023). As in other spider families, species of Diptera are some of the natural enemies of jumping spiders (Gillung & Borkent 2017). Several families in Diptera are parasitic, such as Acroceridae Leach, 1815 (Schlinger 1987; Gillung & Borkent 2017), of which most larvae are obligatory endoparasites of spiders since they need them to complete their development (Gillung & Winterton 2019). Acroceridae are composed of five subfamilies: Acrocerinae, Cyrtinae, Ogcodinae, Panopinae, and Philopotinae (Gillung & Winterton 2019). Currently, the family has 55 genera and approximately 530 species (Gillung & Winterton 2011; Winterton 2012; Schlinger et al. 2013; González et al. 2018). There are records of these flies associated with 27 families of spiders (Gillung & Borkent 2017).

Females of Acroceridae can lay eggs on the vegetation, generally without the need for presence of a host (Schlinger 1987). The first instar is called planidium, which actively searches for spiders crawling on the ground (Schlinger 1981). It is believed that the planidium enters the host through the membranous regions of legs, prosoma, or opisthosoma (Schlinger 1981; 1987). Once inside, the larva moves to the opisthosoma and attaches its spiracle to the book lungs of the host (Schlinger 1981; 1987). The larvae enter in a state of diapause, which duration depends on the species, and once the diapause ends, the last molt is made and the larva begins to feed on the spider from inside. After feeding on the host, it leaves and pupates (Schlinger 1987).

Several studies indicate the occurrence of these parasitoids in a wide spectrum of species of jumping spiders (Schlinger 1987; Larrivé & Borkent 2009; Gillung & Borkent 2017; Yuan et al. 2020). The aim of this study is to report parasitism, for the first time, in *Jollas leucoproctus* (Mello-Leitão, 1944) (Salticidae: Sitticini: Sitticina) by *Ogcodes argentinensis* Schlinger, 1960 (Diptera: Acroceridae: Ogcodinae) and in *Titanattus sciosciae* Rubio, Baigorria & Stolar, 2021 (Salticidae: Thiodinini) by *Acrocera* sp. (Diptera: Acroceridae: Acrocerinae).

A subadult male of *J. leucoproctus* was collected in Sierra de Carapé, Maldonado, Uruguay (34°31'18"S, 54°58'37"W), under a rock (FCE-Ar 11217), and a subadult of *T. sciosciae* was collected in Punta Negra, Maldonado, Uruguay (34°53'14"S, 55°13'07"W) on a bark of a tree (FCE-Ar 14568). In the laboratory, spiders were kept under in plastic petri dishes with a piece of cotton soaked in water and fed with *Drosophila melanogaster ad libitum*. We follow Schlinger et al. (2013)

key to determine the spider fly genus and Schlinger (1960) protocol to dissect and observe the male genitalia in *O. argentinensis*. The material (spiders and flies) is preserved in 75% alcohol and they are deposited in the Colección de Entomología de la Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay (FCE-Ar). Photographs of live specimens were taken with an Olympus Tough TG-4 camera and the specimens in alcohol with a Nikon D3500 adapted to a microscope.

Both spider species were housed under the mentioned laboratory conditions. The temperature of the room averaged $25 \pm 1.18^\circ\text{C}$ ($21\text{--}28^\circ\text{C}$) and humidity was $58.7 \pm 9.6\%$ (50-80%). In both cases, the spiders did not present signs of being parasitized prior to the emergence of the larva. After 32 days, from 12 October 2019 to 13 November 2019, the spider *J. leucoproctus* was found dead (Fig. 1A) and also a male spider fly of *O. argentinensis* appeared (Fig. 1B). In the other case something similar occurred, from the spider *T. sciosciae* (Fig. 2A) with the spider fly *Acrocera* sp. The larva emerged on 19 August 2020 and began to weave threads on one side of the spider (Fig. 2B), then it remained suspended throughout its development. The threads presented small drops in areas close to the individual. After six days, on 25 August 2020, 10 am, the larva was whitish, due to the elimination of waste before pupating, the meconium was visible on the posterior region (Fig. 2C). At 4 pm, on the same day, it began to pupate (Fig. 2D). The next day the pupa changed its color to light-brown (Fig. 2E). Eleven days later, on 06 November 2020, it reached the adult stage, and stayed within the silk threads (Fig. 2F). On 17 November 2020, the adult female left the threads and remained motionless nearby (Fig. 2G).

This is the first record of parasitism in the spider species *J. leucoproctus* and *T. sciosciae* by acrocerids of the *O. argentinensis* species and *Acrocera* genus, respectively. Additionally, one specimen of *O. argentinensis* is recorded as a parasitoid of the jumping spider *Cotinusa trifasciata* (Mello-Leitão, 1943) (Salticinae: Gophoini), collected in El Edén, Maldonado, Uruguay in 2018, but data of the fly development was not recorded. This constitutes the first record of Acroceridae in Uruguay, and in addition, the first record of *O. argentinensis* in another country, being the northernmost record for the species, approximately 300 kilometers from its type location (Chascomús, Buenos Aires, Argentina). The *Acrocera* specimen was not determined at species level because of the scarce information about the genus in this region, where only *Acrocera brasiliensis* Gill-Collado, 1928 (Diptera: Acroceridae: Acrocerinae) is recorded to Rio de



Figure 1. *Ogcodes argentinensis* emerged from *J. leucoproctus*. A. Exoskeleton of sub-adult *J. leucoproctus*. B. Imago of *O. argentinensis*.



Figure 2. Development of *Acrocera* sp. emerged from *T. sciosciae*. A. Sub-adult of *T. sciosciae*. B. Recent emerged larvae and spider's exoskeleton. C. Larvae with meconium. D. Early stage of pupae. E. Pupa. F. Early imago. G. Imago of *Acrocera* sp.

Janeiro, Brazil, but the description of this species do not match with the specimen collected in Uruguay. These new records for the three species of spiders are added to the list of spiders attacked by spider flies (Schlinger 1987; Larrivéé & Borkent 2009; Gillung & Borkent 2017). As observed in other studies, the hosts did not show signs of being parasitized prior to death (Gillung & Winterton 2019; Gabellone et al. 2020). The emergence of the acrocerid larvae was at the spider sub-adult instar, this may be due to higher lipid content in the body of juvenile spider compared to adults (Wilder & Rypstra 2010). But new studies will be necessary to support this assumption. According to our observations, the complete cycle from larvae to adult outside the host lasted a month, corroborating other observations (Larrivéé & Borkent 2009; Barneche et al. 2013). In mygalomorphs, for example, the pupae instar can last 21 days (Gabellone et al. 2020), 27-60 days (Eickstedt 1971), and 41 days (Cady et al. 1993), and in exceptional cases, the complete development can take up to 10 years (Schlinger 1987). Collection of live spiders in the field, then keeping them at the laboratory for further studies is crucial to understanding the life cycles of their parasites and their development. It is known that the most susceptible spiders which get parasitized by Acroceridae are the cursorial ones (Gillung & Borkent 2017). Future studies will focus on the breeding and maintenance of different species of jumping spiders in order to detect associated parasites and record their development.

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Authors' Contributions

DH reared the spiders, registered the development of the fly, and took photos of alive specimens. DH and AL took photos of dead specimens, determined the material, did the layout of figures, reviewed the literature, and wrote the manuscript.

Conflict of Interest Statement

The authors declare no conflict of interest.

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