

Scientific Note

First record of parasitism in *Avicularia purpurea* Kirk, 1990 (Araneae: Theraphosidae: Aviculariinae) by *Notocyphus aff. tyrannicus* Smith, 1855 (Hymenoptera: Notocyphinae) in the Ecuadorian Amazon

Primer reporte de parasitismo en *Avicularia purpurea* Kirk, 1990 (Araneae: Theraphosidae: Aviculariinae) por *Notocyphus aff. tyrannicus* Smith, 1855 (Hymenoptera: Notocyphinae) en la Amazonía Ecuatoriana

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Abstract. A brief note is presented on a first case of parasitism by *Notocyphus aff. tyrannicus* Smith, 1855 on *Avicularia purpurea* Kirk, 1990 in the Amazon region of Ecuador; being a second case of parasitism on Aviculariinae by one Pompilid wasp. Some considerations about predation and behavior are mentioned in discussions.

Key words: Host-parasitoid; interaction; Neotropic; tarantula; wasp.

Resumen. Se presenta una breve nota sobre el primer caso de parasitismo por parte de *Notocyphus aff. tyrannicus* Smith, 1855 sobre *Avicularia purpurea* Kirk, 1990 en la región amazónica de Ecuador; siendo el segundo caso reportado en Aviculariinae por parte de una avispa Pompilidae. Algunas consideraciones sobre la depredación y comportamiento son mencionadas en la discusión.

Palabras clave: Avispa; hospedador-parasitoide; interacción; Neotrópico; tarántula.

Different species of the Theraphosidae family have been shown to be susceptible to being parasitized mainly by nematodes (Pizzi 2009), Diptera (Machkour-M'Rabet *et al.* 2015; Hénaut and Machkour-M'Rabet 2020) and Hymenoptera (Williams 1956; Fernández 2000; Costa *et al.* 2004; Martins *et al.* 2016). Within this group the family Pompilidae is characterized by presenting parasitic relationships with species of the family Theraphosidae. However, despite these interactions being known, very few have been observed and documented. Most of the information corresponds to relationships between these wasps and land spiders (Cambra *et al.* 2004; Costa *et al.* 2004), and there is little information regarding arboreal species (Rego *et al.* 2004).

In this publication we present a case of parasitism by *Notocyphus aff. tyrannicus* Smith, 1855 on *Avicularia purpurea* Kirk, 1990, an arboreal species commonly found in the Ecuadorian Amazon. Despite this, very little is known about their biology in the

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wild and ecological relationships with other species are practically unknown. For what we consider an important contribution this case of parasitism. *Avicularia purpurea* Kirk, 1990, is distributed in the Amazon region of Colombia, Ecuador and Peru (Fukushima & Bertani 2017). It is a species of arboreal habits, which has adapted to live even in anthropogenized areas. In Ecuador, it occupies diverse habitats from cultivated areas, mature and secondary forests and in succession, as well as human dwellings and buildings (Fig. 2). Fukushima & Bertani (2017) report two morphotypes, one with a northern distribution, in Ecuador and Colombia and another to the south, in northern Peru; being the females the ones that differ in appearance, while in the males there are no differences between localities. The northern morph has a brown carapace with short golden setae and a very intense purple shine, carapace edge with long setae of the same color as the dorsal setae of the carapace. All the ventral parts covered by longer setae. Legs and palps with short brown setae with a very intense purple glow and long brown protective setae. Paw rings on whitish distal femurs, tibiae, and metatarsals. The back of the abdomen with long brown protective setae evenly distributed and short black setae with a velvety appearance. The southern morph differs by presenting discreetly gray setae on palps and legs, in addition, it has a less intense purple glow on the short setae of the shell, palps and legs. In turn, it shows a light brown coloration in the abdominal setae, very different from the northern morph, which has a velvety black coloration (Fukushima & Bertani 2017). The wasps of the Pompilidae family can be recognized as authentic spider hunters (Fernández & Sharkey 2006) mainly because their females in general, after mating, actively look for spiders to paralyze them and place an egg, this can occur as a fortuitous encounter or a specialized search (Grout & Brothers 1982). Within the family there are general and specialized species that attack a wide range of spider species (Fernández & Sharkey 2006). Within this group is the subfamily Notocyphinae, a group that lacks reviews of its neotropical species (Fernández 2000), which also presents the behavior of parasitizing spiders (Simons 1989; Martins *et al.* 2016). Notocyphinae is distinguished from other subfamilies of Pompilidae by the large and exposed labrum, sinuous or parallel inner margins of the eyes, and markedly laterally compressed sixth sternal metasomal (Fernández & Sharkey 2006). The genus *Notocyphus* Smith is only known for the subfamily in the Neotropical region, with about a 70 species described (Fernández 2000).

Study Area. During a field exploration on 26th December 2019 in the Amazon region of Ecuador, a juvenile individual of the species *Avicularia purpurea* Kirk, 1990 was captured under scientific authorization N° 002-2019-IC-FAU-DNB/MAE at 9:45 p.m. in a tree at an approximate height of 3 meters, near a populated area in the town of García Moreno, Río Miriumi, Sucúa, Morona Santiago (-2.464747°, -78.185975°), 825 masl (Fig. 1). This area is characterized by presenting a minimum annual average temperature of 16 °C and a maximum of 22 °C, an annual rainfall of 1960.6 mm, and a minimum relative humidity of 75% and a maximum of 100% (Instituto Nacional de Meteorología e Hidrología 2017). The area is within a wooded area, classified as Evergreen Piemontane Forest of the south of the eastern mountain range of the Andes (Ministerio del Ambiente 2013). The vegetation cover has undergone changes in its composition due to logging, replacement by grasslands for livestock and small to medium-scale crops. The original vegetation conserves large continuous areas especially in hillside areas. However, many areas due to pressure and the use that has been given, it has colonized with scrub and forms large patches that give the appearance of not having been altered (Ministerio del Ambiente 2013).

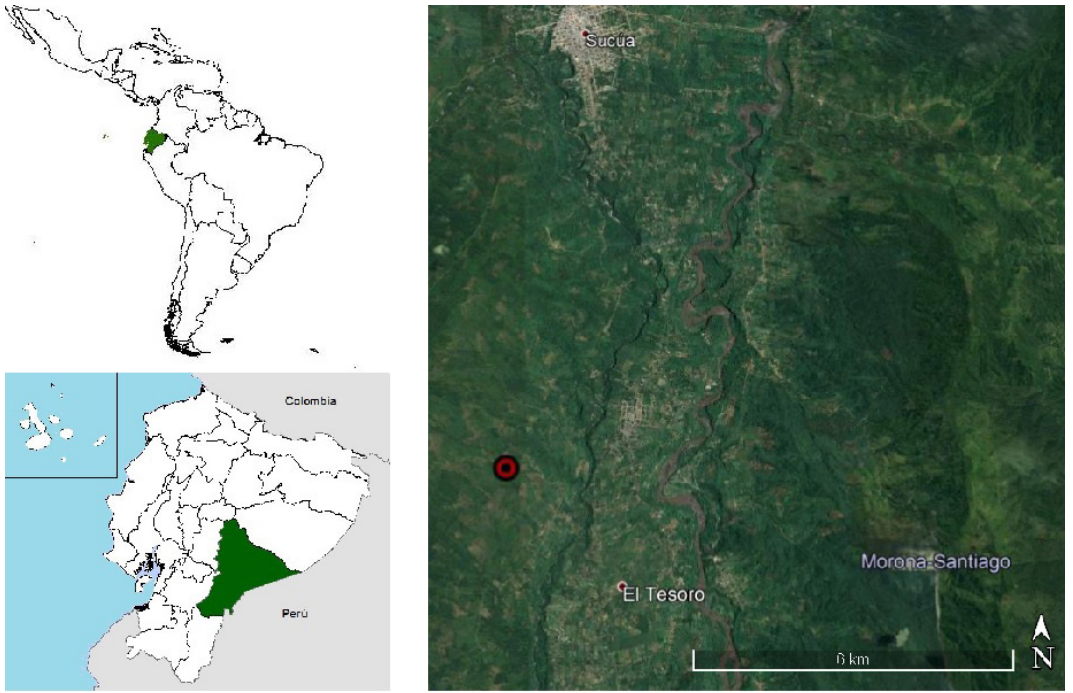


Figure 1. Locality where the specimen of *A. purpurea* parasitized by *Notocyphus* *af.* *tyrannicus* was collected. / Localidad de recolección del espécimen de *A. purpurea* parasitado por *Notocyphus* *af.* *tyrannicus*.

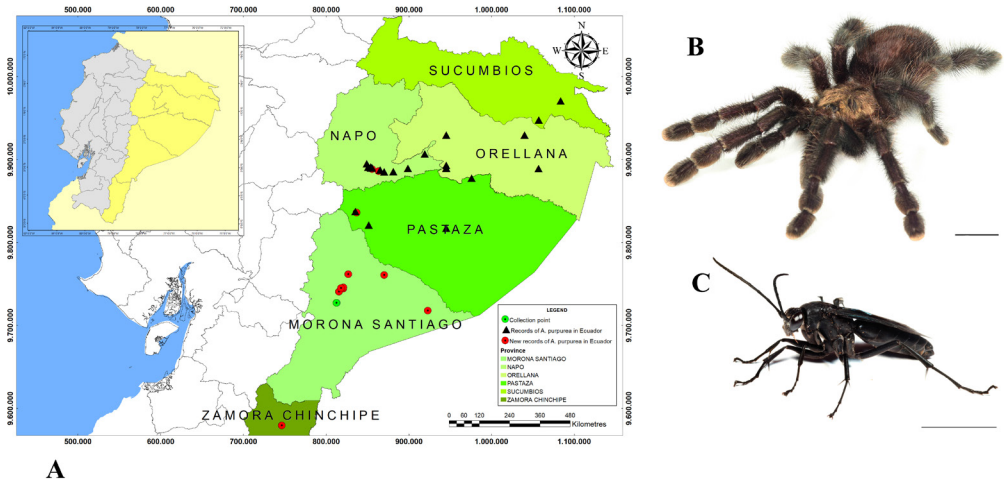


Figure 2. A. Localities of *A. purpurea* in Ecuador. B. Juvenile individual of *A. purpurea* that presented the parasitic larvae of *Notocyphus* *af.* *tyrannicus*. C. Live adult of *N. af.* *tyrannicus*. Scale bar: 1 cm.

All the collected individuals were externally checked to show if they had external parasites such as mites, larvae or others before being deposited in the containers, apparently none individual presented external parasites. The specimen of *A. purpurea* was kept alive, during the expedition, in a plastic container where it was provided with humidity, food

and shelter. After five days of being collected, it made an exuvia and remained in perfect condition, feeding normally, and showing normal behavior. The collected individuals were checked daily, so we noticed a somewhat unusual behavior in the specimen of which mention is made in particular, after four days for having done the exuvia, it had developed a fairly dense and closed silk shelter in which it was kept for seven days. After this, we noticed the presence of a yellowish-brown cocoon inside, with a hairy appearance, with a total length of 27.5 mm and a diameter of 12.6 mm (Fig. 3). The wasp larva had emerged from its host through the opisthosoma area, during the night, leaving it dead. The cocoon was kept in incubation under controlled conditions of temperature (24-28 °C) and humidity (70-85%) until the adult wasp emerged.

The development of the larva was not studied, because it was not known that the spider was parasitized. The adult emerged after 84 days from one end of the cocoon, it has a black coloration with metallic reflections of a bluish tone, the wings are dark with a metallic blue tone, it has a total length of 23.4 mm, distance from the internal margin between the eyes 2.1 mm (Fig. 3).

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The adult wasp was identified using the key for the neotropical subfamilies of Pompilidae based on the phylogenetic analysis of Shimizu (1994), Fernández & Sharkey (2006) at the subfamily level and the taxonomic keys presented by Fox (1897) for genus and species. Due to there is little information, and the keys used to determine the species do not present very marked and differential characters, we opted to define the wasp as related to *Notocyphus tyrannicus*, because we have uncertainty and doubts about its correct name. The morphological characters observed to identify the wasp as *Notocyphus aff. tyrannicus* were: (1) thorax and abdomen completely black; (2) dark wings; (3) head in front, not spotted; (4) completely black antennae; (5) antennae clearly longer than head and thorax combined; (6) posterior ocelli separated by a distance at least equal to that between them and the nearest ocular margin; (7) labrum almost as long as the clypeus; (8) clypeus broad, narrowed anteriorly and emarginated; (9) the first joint of the flagellum longer than the second; (10) pronotum rounded anterolaterally, arched posteriorly, almost as long as the scutellum (Fox 1897). The specimen was photographed in life, as well as after preservation. It was prepared following the methodology proposed by Luna (2005).

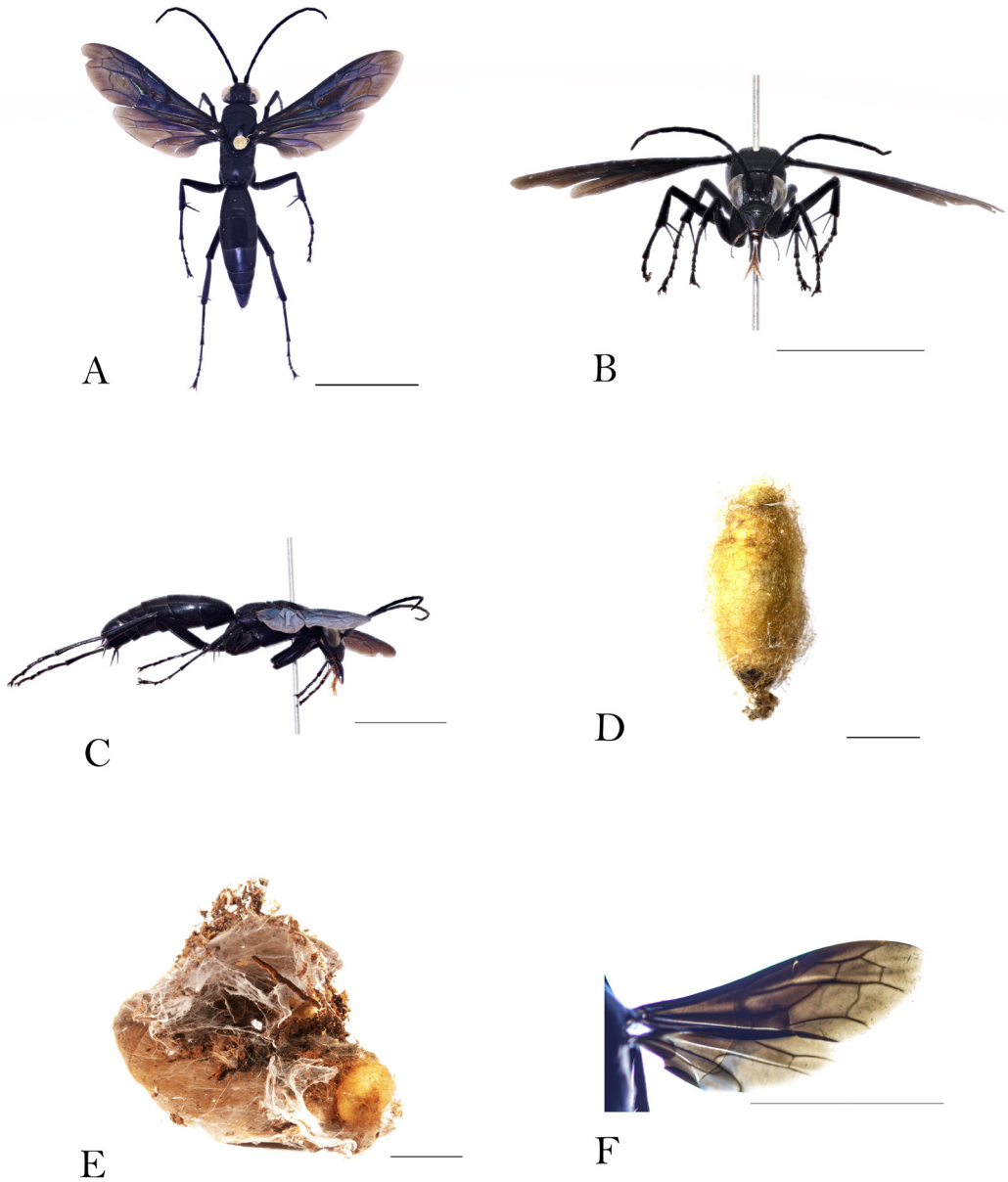


Figure 3. A. Dorsal view of *N. aff. tyrannicus*. B. Front view. C. Side view. D. Cocoon of *N. aff. tyrannicus*. E. Silk shelter made by *A. purpurea*, note the cocoon at one end. F. Wing detail of *N. aff. tyrannicus*. Scale bar: 1 cm.

Discussion

Several publications are known about cases of parasitism by pompilid wasps in spiders of the Theraphosidae family, especially in terrestrial species (Petrunkevitch 1926; Punzo 1994; Costa *et al.* 2004) and very little information known or published in arboreal species (Rego *et al.* 2004), so it is an interesting case of ecological relationships in arboreal species. Martins *et al.* (2016) report a case of parasitism by *Notocyphus tyrannicus* on an indeterminate species of *Acanthoscurria* Ausserer, 1871 (Theraphosidae: Theraphosinae) and Williams (1928) recorded a female of *N. tyrannicus* hunting an arboreal theraphosid spider,

probably of the genus *Tapinauchenius* Ausserer, 1871. In particular, due to Pompilidae wasp parasitism on tarantulas is known to cause paralysis in spiders, and wasps generally bury their victims in holes dug by themselves in the ground or by using the burrows of the tarantulas on which they parasitize (Costa *et al.* 2004).

In this case, the spider showed normal behavior, even exuviating, feeding and moving normally until the moment the larva emerged from it. We believe that it is another strategy in these wasps to avoid the energy expenditure of carrying a prey of considerable size for them on the ground, according to Rego *et al.* (2004) in a particular case of predation by *Pepsis frivaldszkyi* Mocsáry on a spider *Avicularia* sp. mention that the wasp ingests the spilled fluids of the spider to recover energy. On the other hand, in our case, leaving an egg in the living spider could mean a huge saving of energy, and the spider, by maintaining a normal behavior, can hunt and generate a greater amount of body mass, which will then be used by the larva of the wasp, at the same time, the fact that the spider has made a silk shelter, protects the cocoon inside and keeps it safe from possible predators or other parasitic insects that affect the development of the wasp (Hubbard *et al.* 1987; Peruquetti & Lama 2003; Benamu *et al.* 2020), these observations are consistent with the publication by Benamu *et al.* (2020) in which they mention that *Lycosa* spp. parasitized by the wasp *Minagenia* sp. show a behavioral change where they make a silk chamber to protect the pupa of the parasitoid. Compared to other pompilid wasps, especially of the genus *Pepsis* Fabricius (Petrunkevitch 1926; Punzo 1994), *N. aff. tyrannicus* had a relatively short development for a wasp of considerable size, however its development is similar to those studied in *Notocyphus tyrannicus* in the Brazilian region by Lourenço (1979), which presented a development of 73 days; in turn Byrne (2016) mentions that the *Notocyphus dorsalis arizonicus* Townes development lasted 71 days, so it agrees with the cycle observed in our case.

We do not know how the wasp attacked the spider or if it laid directly on it or in its shelter. With these considerations, we believe that this species avoids wasting energy in the fight and transport of its host, in turn, as with other parasitic organisms, the larva would "control" the spider to make a refuge and protect itself while it develops (Godfray 1994; Zaldívar-Riverón *et al.* 2008).

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