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New data on the distribution of *Aguapanela arvi* Perafán, Cifuentes & Estrada, 2015 in Colombia through collections and citizen science, with notes on the natural history (Araneae: Theraphosidae)

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Abstract
This paper expands the known distribution of *Aguapanela arvi* Perafán, Cifuentes & Estrada, 2015 in Colombia by reporting its presence for the first time in the departments of Caldas, Quindío, and Risaralda. Additionally, new aspects of its natural history are documented, including parasitic interactions involving a parasitoid wasp and an arthropod-pathogenic fungus. These findings are based on field observations, specimens deposited in biological collections, and citizen science records.

Keywords: Andean region; Biological observations; Community science; Mygalomorphae; New records; Parasitism; Tarantula; Theraphosinae.

Introduction

The family Theraphosidae Thorell, 1869, the largest among the mygalomorph spiders, commonly known as tarantulas or bird-eating spiders, comprises approximately 1,193 species classified into 187 genera (World Spider Catalog 2025) and occurs on all continents except Antarctica (Lüddecke et al. 2018). This group has developed a wide range of adaptations due to its rich species diversity, variety of habitats, and ecological niches, leading to a wide range of morphological variation and ecological strategies (Foley et al. 2019). Tarantulas are generalist predators and play an important role in terrestrial ecosystems by regulating populations of invertebrates and small vertebrates (Bolaño-Manjarres et al. 2023). Despite the great biological diversity found in Colombian ecosystems, groups with high species diversity, such as arachnids, remain poorly studied. Among the five subfamilies of Theraphosidae found in the Neotropics, the subfamily Theraphosinae is the most diverse, inhabiting a wide variety of habitats (Pérez-Miles & Perafán 2017). In Colombia, Theraphosinae has been recorded across all natural regions of the country, including the Andes, the Caribbean, the Pacific, the Orinoquía, the Amazon, and the Insular Region (Valencia-Cuellar et al. 2019). However, its diversity is probably still underestimated, which makes it difficult to understand the biological and ecological characteristics of these species.

Aguapanela arvi Perafán, Cifuentes & Estrada, 2015 is a monotypic species of terrestrial tarantula that inhabits high-Andean forest ecosystems. It was originally described from the Central Cordillera of the Colombian Andes at elevations between 2100 and 2400 meters above sea level in the department of Antioquia (Fig. 1), and its type locality is host to a great diversity of Mygalomorphae. Although it was previously assumed that Theraphosidae are not common in highland areas, species such as *Agnostopelma gardel* Pérez-Miles & Weinmann 2010, *Agnostopelma tota* Pérez-Miles & Weinmann, 2010, *Pamphobeteus verdolaga* Cifuentes, Perafán & Estrada-Gomez, 2016, *Spinosatibiapalpus spinulopalpus*

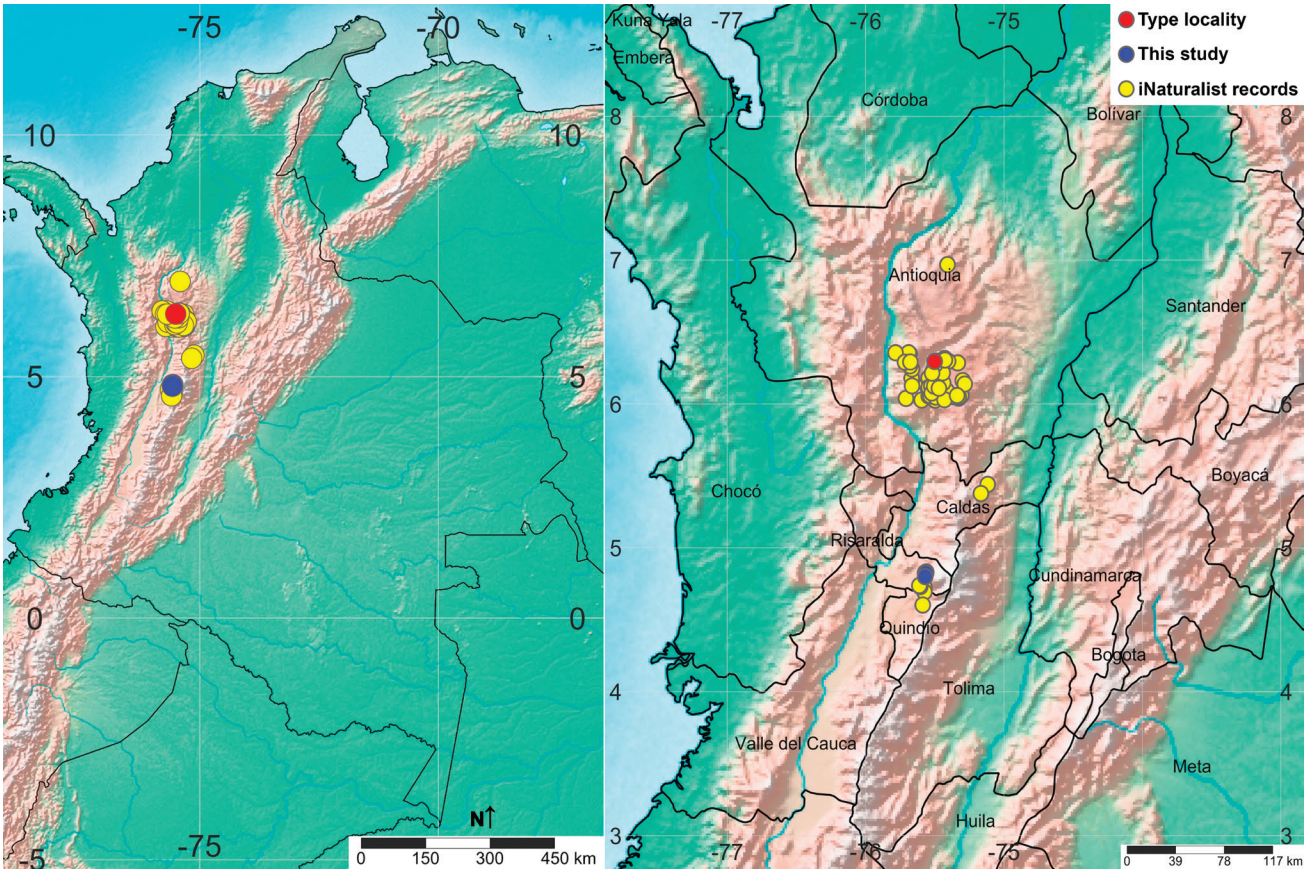

Fig. 1 – Known distribution of *Aguapanela arvi* Perafán, Cifuentes & Estrada, 2015 in Colombia.

(Schmidt & Weinmann, 1997), and *A. arvi* have been documented above 2000 meters above sea level in the Colombian Andes in recent studies (Pérez-Miles & Weinmann 2010; Perafán et al. 2015; Cifuentes et al. 2016; Gabriel & Sherwood 2020). Despite the increasing number of records, sampling efforts and georeferenced data remain scarce, and are essential for understanding the species' biogeography. This study presents new distribution records for *A. arvi*, which is endemic to the Colombian Andes, and provides new data on its natural history based on biological collections, personal observations, and online citizen science platforms.

Materials and Methods

Data were obtained from field surveys conducted between 2020 and 2024 in the municipality of Santa Rosa de Cabal, Risaralda, Colombia, specifically in the localities of Vereda San Ramón, vía Minas del Chaquiro and Reserva Natural Alto de la Virgen, which correspond to montane cloud forests between 1800 and 2500 meters above sea level. These ecosystems are characterized by forests in a state of succession, a result of livestock and agricultural activity in previous years. Although there are extensive patches of vegetation with mature plants, traces of human activity are evident in the ecosystem composition. The specimens were preserved in 70% ethanol and deposited in the Colección Entomológica de la Corporación Universitaria Santa Rosa de Cabal (CUS-E; curator: Shirley Palacios-Castro). Genitalia and urticating setae were extracted and manually cleared, stored in vials with specimens and examined using an AmScope SMZK-1TS stereomicroscope and an Advanced Optical UB200i-TR microscope, specimens were subsequently identified based on the original description by Perafán et al. (2015). In addition, records from the iNaturalist platform were included, each observation was reviewed to verify that it indeed pertained to the species *A. arvi*. The distribution maps were created using SimpleMappr (Shorthouse 2010).

Results

Family Theraphosidae Thorell, 1869

***Aguapanela arvi* Perafán, Cifuentes & Estrada, 2015.**

(Figs 2-3).

This study presents five records from specimens deposited in biological collections and 87 records obtained from the iNaturalist platform. The species *A. arvi* is reported for the first time in departments such as Caldas, Quindío and Risaralda.

Material examined. COLOMBIA: Risaralda, Santa Rosa de Cabal, Vereda San Ramón. 1996 m. 4.83265, -75.56246. 25 Feb 2022. Direct capture. Álvarez-Arellano D. & Moreno-García R leg, 1 ♂ (CUS-E ADTP SIAU A-01); Risaralda, Santa Rosa de Cabal, Vereda San Ramón. 1996 m. 4.82726, -75.57070. 16 Ago 2022. Direct capture. Álvarez-Arellano D. & Moreno-García R leg, 1 ♀ (CUS-E ADTP SIAU A-02); Risaralda, Santa Rosa de Cabal, Vía Minas, Vía Cascada La Bonita. 2026 m. 4.825768, -75,562805. 13 Dec 2023. Direct capture. Aguirre-Cano D. leg, 1 ♀ (CUS-E Ar-10); Risaralda, Santa Rosa de Cabal, Vía Minas, Vía Cascada La Bonita. 2026 m. 4.825768, -75,562805. 13 Dec 2023. Direct capture. Aguirre-Cano D. leg, 1 ♂ (CUS-E Ar-11); Risaralda, Santa Rosa de Cabal, Vía Minas, Vía Cascada La Bonita. 2327 m. 4.800491139, -75.5702412. 04 Jun 2023. Direct capture. Aguirre-Cano D. & Moreno-García R. leg, 1 ♀ (CUS-E Ar-76).

Diagnosis. According to Perafán et al. (2015), this species can be distinguished from other Theraphosidae by the following characteristics: plumose stridulatory setae on the coxae, trochanters and femora of legs I and II, urticating setae types III and IV, and the reduced number of labial cuspules.

Males: differ from those of other Theraphosinae by the lack of a tibial apophysis on leg I; palpal bulb with the subtegulum less extended than usual in Theraphosinae; elongated curved embolus, ventrally concave; two prolateral keels very flat and developed on the dorsal edge. Color alive: cephalothorax, abdomen and legs black, femur darker; legs with reddish long setae. Abdomen ornamented with red long setae and dark patch of urticating setae.

Females: differ from those of other Theraphosinae by having spermathecae with two digitiform elongated and granulated seminal receptacles, distally wide and rounded, attached to a semicircular wide membranous base. Color alive: as in male, but abdomen with red long setae abundant laterally.

Distribution. Colombia: Antioquia, Caldas, Quindío, Risaralda. (Fig. 1).

Natural history. The specimens found during fieldwork were observed exhibiting strong defensive behavior, which consisted of raising the palps and the first pair of legs while exposing the fangs, and in many cases with a drop of venom emerging from them (Fig. 2C). These observations are largely consistent with those documented in the original description of the species by Perafán et al. (2015). Furthermore, when disturbed, individuals displayed attack behavior, accompanied by a faint but distinct stridulatory sound.

One of the observations made by citizen science documented an attempt at predation or parasitism by a spider-hunting wasp (Hymenoptera: Pompilidae) (Fig. 3C); the wasp is most likely *Pepsis montezuma* Smith, 1855, based on its typical coloration, characterized by orange-amber wings with a dark apical band, occasionally entirely dark but never with a well-defined central transverse band, as well as its widespread distribution in the area (Vardy 2005; Aguirre-Cano & Álvarez-Arellano, unpublished work). The individual was observed carrying its prey by dragging it while walking backward, most likely toward a pre-existing cavity it had previously constructed.

Another case of parasitism was observed in a specimen infected with an arthropod-pathogenic fungus (Fig. 2B), found on August 5, 2020 buried under a dead tree trunk in the locality Vía Minas del Chaquiro. The fungus was determined as *Cordyceps cf. caloceroides* Berk. & M.A. Curtis based on morphology and habitus—including the presence of long, brightly colored, filiform stromata emerging from the host's joints—the low oxygen concentration under the dead tree trunk, and by being the only species currently known to parasite Theraphosidae spiders in Colombia (Chiriví et al. 2017).

Discussion

The results, based on personal observations, collected specimens, and iNaturalist records, confirm that *Aguapanela arvi* is a common species widely distributed throughout the Central Cordillera of the Colombian Andes (Fig. 1). Most records originate from the department of Antioquia, specifically from the western and central slopes of the mountain range; in contrast, the two records from the department of Caldas are from the eastern slope, representing the first records from this sector of the Central Cordillera. Records from the departments of Quindío and Risaralda represent the southernmost known distribution data for the species to date. Users of the platform have correctly identified the species in most cases, demonstrating that the general public has also come to recognize it. In addition, some of these observations have revealed new natural history data and corroborated previously documented findings, thereby contributing to our understanding of this species.

Aguapanela arvi differs from other Theraphosidae by the presence of plumose stridulatory setae on the coxae, trochanters, and femora of legs I and II, and by the presence of types III and IV urticating setae. It has been suggested that, in their defensive behaviors, these stridulatory setae play a very important role in the production of stridulation, as these appendages rub against one another (Perafán et al. 2015; Pérez-Miles & Perafán 2022). The defensive behavior observed here is consistent with that reported in the original description of the species (Perafán et al. 2015). In addition, we note that the stridulations produced are audible to the human ear.

Although there are several records of Pompilidae host associations in the Neotropics, records involving Theraphosidae in Colombia remain scarce; in the few documented cases, the arachnid host has rarely been identified to the genus level (Kurczewski et al. 2024). There are only records

of wasps belonging to the genera *Pepsis* Fabricius, 1805 and *Priocnessus* Banks, 1925 parasitizing Theraphosidae in the country (Restrepo-Giraldo et al. 2012; Kurczewski & West 2026). The species *Pepsis montezuma* is the first parasitoid wasp documented on *Aguapanela arvi*. This species is widely distributed in Colombian high mountains, and the morphological characteristics visible in the photograph are consistent with its identification. Additionally, the size range of this

Fig. 2 – Records from this study of *Aguapanela arvi*. **A,** male (left) and female (right). Photo: Diego Álvarez-Arellano; **B,** an individual parasitized by the arthropod-pathogenic fungus *Cordyceps cf. caloceroides*. Photo: Ronald Moreno-García; **C,** specimen exhibiting defensive behavior. Photo: Brayan Carmona-Aguirre; **D,** male palpal bulb; **E,** urticating setae type IV; **F,** female spermathecae.

Fig. 3 – Records of *Aguapanela arvi* from iNaturalist. Photos provided by users: **A,** juanandino; **B,** estebanalzate; **C,** dugomotos; **D,** sesernam; **E,** khristimantis; **F,** felipe_barrerao.

species (body length 18–33 mm) is consistent with *A. arvi* serving as a suitable host. It is possible that other sympatric species such as *Pepsis sumptuosa* Smith, 1855 may not prefer *A. arvi* as a host due to its large size, instead preferring larger tarantulas such as those of the genus *Pamphobeteus* Pocock, 1901 (Kurczewski et al. 2020). Another parasitoid

wasp species similar in appearance is *Pepsis basifusca* Lucas, 1895; however, it differs in that the apical band of the forewing occupies more than half the width of the area beyond the cells and closer to them, extending all the way to the wing apex (Vardy 2005). Furthermore, this species has not been reported in Colombia yet and is considered restricted to Central America (Fernández et al. 2022).

Arthropod-pathogenic fungi on mygalomorph spiders are poorly documented. Most reports of fungal infections in mygalomorphs involve trapdoor spiders in the families Actinopodidae, Barychelidae, Halonoproctidae, Idiopidae and Pycnothelidae, and are primarily attributed to species in the genera *Cordyceps* Fr. and *Purpureocillium* Luangsa-ard et al. (Nyffeler & Hywel-Jones 2024). The genus *Cordyceps* has been recorded in the Neotropics as a pathogen of Theraphosidae through the species *Cordyceps ignota* Marchion. and *Cordyceps caloceroides* Berk. & M.A. Curtis. The former was reported infecting a large theraphosid spider in Argentina (Mains 1954), whereas *C. caloceroides* has been documented in several countries, including Ecuador on Theraphosidae spp. (Hennings 1897; Chiriví et al. 2017) and Brazil on the genus *Grammostola* Simon, 1892 and the species *Pterinopelma vitiosum* (Keyserling, 1891) (Barbosa et al. 2016). In Colombia, *C. caloceroides* has been recorded in various locations, but all records are limited to host identification at the family level (Chiriví et al. 2017). The only record with a more precise taxonomic identification corresponds to the genus *Pamphobeteus* (Ávila-Guerrero, unpublished thesis). Our record therefore represents the first species-level host identification for the genus *Cordyceps* in Colombia and the first documented fungal pathogen of *Aguapanela arvi*.

Data provided by citizen science, combined with data from existing collections, have proven to be an effective method for determining species distributions and changes over time, particularly for species with limited documentation (Wang et al. 2018). For example, in South Africa, citizen science has become a key tool for expanding knowledge of the distribution of baboon spiders (Theraphosidae), revealing numerous observations of different species contributed by citizens and helping to fill gaps in our understanding of this group (Campbell & Engelbrecht 2017). Another successful example of advancing taxonomic knowledge through online platforms is provided by Mercado (2025), who documented 13 spider species in Puerto Rico and the U.S. Virgin Islands that had not been previously recorded.

Similarly, our findings contribute significantly to our understanding of *Aguapanela arvi*, demonstrating the potential of citizen science, especially through online platforms that facilitate the rapid collection and sharing of biodiversity data. This approach, combined with data from biological collections, can enhance conservation efforts by improving knowledge of the species distribution, ecology, biotic interactions, and potential threats. It also helps identify species occurrences and detect temporal changes in their distribution, which helps identify habitat loss, environmental pressures, and illegal trade, where Theraphosidae are among the most traded invertebrates (McKinley et al. 2017; Fukushima et al. 2019; Caldas et al. 2018). In this regard, the integration of citizen science enables large-scale monitoring across time and space, something that poses a challenge for traditional approaches (McKinley et al. 2017). This strategy is particularly valuable for groups that are often considered uncharismatic, such as arthropods; for this reason, we strongly recommend increasing public participation in scientific initiatives, as it improves data availability and promotes more inclusive and scalable research approaches.

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