

First record of *Tropicosa thorelli* (Araneae: Lycosidae) attacking the dragonfly *Rhionaeschna marchali* (Odonata: Aeshnidae)

Primer registro de *Tropicosa thorelli* (Araneae: Lycosidae) atacando a la libélula *Rhionaeschna marchali* (Odonata: Aeshnidae)

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Abstract

This study records thirteen predation attempts by the wolf spider *Tropicosa thorelli* (Keyserling) on males of the aeshnid dragonfly *Rhionaeschna marchali* (Rambur) in a protected area of the Colombian Andes. All events occurred on macrophyte vegetation near the shoreline of the Tominé Reservoir, at the locality of Club Náutico El Muña. For each event, we recorded perch height, time of occurrence, attack duration, and ambient temperature. The observations took place between 11:01 and 11:47 h during the dry season, under temperatures ranging from 21.2 to 23.7 °C. The mean duration of attack events was 12.72 ± 2.41 min. In all cases, the attacks were interrupted by the arrival of *R. marchali* males, although the mechanisms underlying this behavior remain unclear. These observations suggest that perch characteristics, particularly perch height, may influence the vulnerability of *R. marchali* males to predation by sit-and-wait spiders.

Keywords: trophic interaction, habitat structure, behavioral interference, shoreline microhabitat, aquatic–terrestrial interface, predation risk.

Resumen

Este estudio registra trece intentos de depredación por parte de la araña lobo *Tropicosa thorelli* (Keyserling) sobre machos de la libélula *Rhionaeschna marchali* (Rambur) en un área protegida de los Andes colombianos. Todos los eventos ocurrieron sobre vegetación de macrófitas cercana a la orilla del embalse de Tominé, en la localidad de Club Náutico El Muña. Para cada evento se registraron datos como la altura de la percha, la hora de ocurrencia, la duración del ataque y la temperatura ambiente. Las observaciones tuvieron lugar entre las 11:01 y las 11:47 h durante la estación seca, con temperaturas entre 21,2 y 23,7 °C. La duración media de los eventos de ataque fue de $12,72 \pm 2,41$ min. En todos los casos, los ataques fueron interrumpidos por la llegada de otros machos de *R. marchali*, aunque los mecanismos que explican este comportamiento aún no son claros. Estas observaciones sugieren que las características de la percha, en particular su altura, pueden influir en la vulnerabilidad de los machos de *R. marchali* frente a la depredación de arañas que emplean estrategias de caza al acecho.

Palabras clave: interacción trófica, estructura del hábitat, interferencia conductual, microhábitat de orilla, interfaz acuático-terrestre, riesgo de depredación.

Introduction

Predator–prey interactions are fundamental to understanding energy transfer in food webs and the organization of ecological communities (Krebs, 2010). Predatory arthropods, in particular, play a central role in these processes, as many species exhibit generalist feeding strategies and occupy multiple trophic pathways within natural systems (Snyder & Evans, 2006). Among them, odonates (dragonflies and damselflies) and arachnids (spiders and others) are important components of energy flow in ecosystems, regulating populations of other organisms and, in turn, serving as prey for higher trophic levels (e.g., Van Buskirk, 2001). Spiders are predominantly carnivorous and exert substantial predation pressure on arthropod communities, consuming an estimated 60 million tons of prey monthly, mainly insects (Nyffeler & Birkhofer, 2017).

Predation of odonates by spiders has been repeatedly documented, with over 100 spider species reported to prey on over 200 Odonata species (reviewed by Palacino-Rodríguez et al., 2025). Although most spider species are generalist predators capable of including herbivores and detritivores in their diet (Birkhofer & Wolters, 2012), they may also prey on other predators, including odonates and other spiders (Palacino-Rodríguez et al., 2023). Within this

context, wolf spider species (Araneae: Lycosidae) are active hunters that do not construct capture webs but instead forage primarily on the ground. While their diet consists mainly of insects (Tripathy & Priyadarshini, 2022), some species have been recorded consuming small vertebrates such as lizards (e.g., Zdunek & Bandara, 2022) and frogs (Youngquist & Sitvarin, 2015). Lycosids typically exploit prey through active pursuit, vegetation climbing, or by capturing arthropods that fall to the ground due to disturbance or dispersal (Winder et al., 1994; Lang et al., 1999). Additionally, certain species can walk and hunt on water as easily as on land (Foelix, 1996).

According to Paredes-Munguía et al. (2023), *Tropicosa thorelli* (Keyserling, 1877) (Araneae: Lycosidae) is a medium-sized wolf spider (9–15 mm body length) (Figure 1A). It is characterized by dark brown lateral areas on the cephalothorax and abdomen, with a continuous pale yellow submarginal spot; a yellow sternum bearing a black spot; brown-orange chelicerae; a dorsally blackish-brown abdomen with yellow markings; and a yellow ventral region (Costa & Capocasa, 1983). Males possess a short, sword-shaped terminal apophysis and a minute tegular keel (Paredes-Munguía et al., 2023). In contrast, females exhibit deep hoods with a diagonal border and a triangular spermathecal head (Paredes-Munguía et al., 2023).

Rhionaeschna marchali (Rambur, 1842) (Odonata: Aeshnidae) is a large, territorial dragonfly measuring 56–63.5 mm in body length (Figure 1B). It presents yellow mesepimeral and metepimeral thoracic stripes and a pale reddish-brown abdomen marked with light blue and yellow spots (von Ellenrieder, 2003). In males, diagnostic features include a well-developed subbasal tooth on the cercus forming an orthogonal angle, a prominently projecting anterior hamular process (up to 50% of its width), a pterothorax with pale stripes, and a membranule that is pale except for the distal 30–50%, which is dark. The frontal carina is evenly curved in dorsal view, and the cercus exhibits a marked dorsal constriction at the distal quarter. Females are characterized by a complete medio-longitudinal pale stripe on abdominal segment II, supratrangles crossed by one to four crossveins, and a pale mesanepisternal stripe that is incomplete or absent (von Ellenrieder, 2003).

At the Tominé Reservoir (Club Náutico El Muña locality), adult males of *R. marchali* patrol territories extending several hundred meters along the shoreline, flying over floating macrophyte plants in search of females. Although they may perch on branches at heights ≥ 2 meters, they are more frequently observed on herbaceous stems at least 20 cm tall within adjacent grasslands (Palacino-Rodríguez et al., 2023). Perching below this height near water is uncommon. Females approach the shoreline primarily for oviposition on macrophyte stems.

In this study, we document for the first time a predation event in which *Tropicosa thorelli* attacks *Rhionaeschna marchali*. This record contributes to the documentation of interspecific interactions between lycosid spiders and dragonflies. It provides empirical evidence of trophic linkages operating at the terrestrial-aquatic interface in the tropical Andean region.

Materials and methods

Attack events were recorded at Club Náutico El Muña (4°50'9.8"N, 73°55'0.7"W), a protected area located

near Bogotá in the Colombian Andean region (2,600 m a.s.l.). Both spiders and dragonflies occur in ecotonal habitats associated with Andean vegetation and freshwater environments. The terrestrial vegetation comprises native Andean Forest species intermixed with introduced plants (see Palacino-Rodríguez et al., 2023). Aquatic and semi-aquatic vegetation includes macrophytes such as *Pontederia crassipes* (Mart.); *Lemna gibba* Linnaeus, 1753, *Commelina* sp.; and pasture grasses along the shoreline (Palacino-Rodríguez et al., 2023).

Individuals of spiders and dragonflies were identified using the keys of Paredes-Munguia et al. (2023) and von Ellenrieder (2003), respectively; these keys rely on external morphological characters and do not require genital examination. No voucher specimens were collected. Spiders and dragonflies were captured with an entomological net. Spiders were temporarily placed in empty 50-ml Eppendorf vials for examination and subsequently released at their capture site. Dragonflies were similarly identified and subsequently released in the vegetation near the location where observed behavior occurred.

The first predation event was recorded on 20 September 2021 during a demographic study in which adult *R. marchali* were marked and monitored near the confluence of the stream and the reservoir. Following this initial observation, periodic monitoring was implemented to detect additional attacks of *T. thorelli* on *R. marchali*. Surveys were conducted from 21 September 2021 to 25 February 2022.

Observations were carried out along a 500 x 3 m transect, following a modified fixed-area transect approach based on the Odonate Sampling Protocol (OSP) (Cezário et al., 2021). Sampling occurred during the dry season, when reduced water levels and elevated temperatures promote reproductive aggregation in odonates (de Resende et al., 2021). The transect was walked at a constant pace, and all observed attacks were recorded. Monitoring was conducted between 1000 and 1700 h, corresponding to the peak activity period of *R. marchali*, using direct observation and 10 x 50 binoculars (JHOPT™, Brighton, CO, USA).

For each event, we recorded perch height, attack duration (from the sting to the spider's abandonment of the site), time of day, and ambient temperature. Temperature was measured using a digital environmental thermometer (Hanna HI98509, Bogotá, Colombia).

Although the number of recorded events was limited, we explored potential associations between attack duration (response variable) and three predictor variables: time of day, perch height, and ambient temperature at the time of the attack. Generalized Linear Models (GLMs) were fitted, and model residuals were examined to assess normality, homoscedasticity, and the absence of overdispersion (Zuur et al., 2009). All analyses were conducted in R (R Core Team, 2022) using the *glm* function in the lme4 package (Bates et al., 2015). Data visualization was performed with ggplot2 (Wickham, 2016) (see Supplementary material 1-S1).

Results

A total of 13 predation events were recorded between 11:01 and 13:47 h (Colombia Time, UTC-5) during the dry season, on 20 September 2021; 18 and 27 December 2021; and 08, 11, 23, 25, and 29 January; and 04, 07, 11, 17, and 21 February 2022. Ambient temperature during observations ranged from 21.2 to 23.7 °C (22.37 ± 0.82). Average attack duration was 12.72 ± 2.41 min, and average perch height was 12.31 ± 2.63 cm (Table 1). Among the evaluated predictors, perch height showed the strongest association with attack duration (Table 2; Supplementary material S1).

In all events, individuals of *T. thorelli* were positioned on leaves of *Pontederia crassipes* at the water's edge, coinciding spatially with perching sites used by male *R. marchali*. When a male *R. marchali* landed, the spider approached slowly, typically inducing the dragonfly to abandon the perch (except on 11 and 23 January). Immediately after, the same or another male occupied the same perch, at which point the spider lunged and bit the dragonfly near the head.

During events recorded in January and in the final February observation, attacked dragonflies struggled to free themselves from the spider. Successful release occurred only on 23 January and 07 February. In the remaining cases, a second male *R. marchali* approached the bitten individual, prompting the spider to release its prey. The bitten dragonfly then remained motionless on the water surface (Figure 2). Subsequently, additional males approached or hovered over the immobile individual while the spider remained nearby. Approximately five minutes later, the dragonfly ceased movement entirely, after which the spider eventually abandoned the site.

Although continued monitoring was planned, seasonal flooding during the rainy period modified shoreline structure and vegetation. Under these conditions, *R. marchali* males continued to patrol and perch along the flooded margins, whereas *T. thorelli* was no longer observed in the same microhabitats. No additional predation events were recorded.

Notably, in the observations of 27 December 2021, 11 January and 07 February 2022, males of *R. marchali* continued to approach floating, previously attacked individuals for more than one hour after the spider had departed. Since spiders were not marked individually, we cannot determine whether repeated attacks involved the same individual. However, three predation events occurred on the same perch.

Discussion

Predation of odonates by lycosid spiders has been previously documented. For example, predation on *Calopteryx maculata* (Palisot de Beauvois, 1807) by an unidentified lycosid species was recorded near aquatic habitats (Waage, 1972). In another case, reduced abundance of *Leptagrion andromache* Hagen in Selys, 1876 larvae was associated with the presence of the web-building wolf spider *Aglaoctenus castaneus* (Mello-Leitão, 1942). However, that effect was likely indirect, resulting from web interference with adult oviposition in bromeliad microhabitats rather than direct predation on larvae or adults.

Prey size and type in spiders are shaped by functional traits such as body size and hunting strategy (Birkhofer et al., 2022). Wolf spiders are abundant, generalist predators across diverse ecosystems (Ekschmitt et al., 1997; Lang et al., 1999). Their predatory success is associated with rapid locomotion, well-developed vision (Clemente et al., 2010), and ambush behavior, often remaining motionless prior to attack (Edgar, 2009). When subduing relatively large prey, lycosids may use their legs to form a basket-like structure around the prey and reposition themselves if the prey attempts to escape (Rovner, 1980).

In the events reported here, interference by male *R. marchali* frequently coincided with prey release. When a second male approached the bitten individual, *T. thorelli* was often unable to maintain its grip, particularly as the dragonfly remained on the water surface, where manipulation may be mechanically constrained. It is possible that the initial, critical point of capture was ineffective in these cases (Rovner, 1980).

The behavior of male *R. marchali* approaching bitten individuals remains unclear. It may reflect perch competition, territorial harassment, simple curiosity, or some form of altruism (e.g., reciprocal altruism) in which males aim to protect other males from predators. Our unpublished observations indicate that the patrol behavior of *R. marchali* resembles that described for other aeshnids, such as *Aeshna cyanea* (Müller, 1764), which conduct both extensive shoreline patrols and more localized flights near potential oviposition sites (Ambrus, 1996). The spider attacks described here occurred during these localized patrols. Given that males and females exhibit similar coloration patterns, and that females approach the water primarily for oviposition, males may initially misinterpret motionless, attacked males as females.

In other aeshnids, males can visually detect immobile (thanatotic) females, even against cryptic backgrounds (reviewed by Wildermuth et al., 2019). Females employ thanatosis to reduce male harassment, yet males often attempt copulation despite the female's immobility. Although

speculative, a similar perceptual mechanism could explain why male *R. marchali* repeatedly approached floating, incapacitated males following spider attacks. (Wildermuth et al., 2019).

During the study period, wolf spiders were abundant near the shoreline. As in other lycosids, *T. thorelli* may exploit a broad prey spectrum, potentially including aquatic Heteroptera (Ishijima et al., 2006), thereby positioning odonates as opportunistic, high-biomass prey items. Large prey may represent energetically profitable resources that contribute to maintaining or even increasing population densities (Riechert, 1999). Notably, in each event the spider remained motionless near the immobilized dragonfly for several minutes (5.66 ± 0.31 min), even while other males approached. Such immobility is consistent with typical lycosid ambush behavior, in which the predator remains stationary until their prey moves again, allowing it to attempt another capture (Clemente et al., 2010).

Although the number of recorded events was limited, our observations reinforce the role of odonates as prey for spiders in littoral habitats. *Rhionaeschna marchali* has been reported as a frequent prey item of *Argiope trifasciata* (Forsskål, 1775) in the same locality as this report (Palacino-Rodríguez et al., 2023), where predation was associated with perching on taller grasses. In contrast, the present study documents predation attempts on individuals perched very close to the water surface (12.31 ± 2.63 cm), a behavior not commonly emphasized in previous reports. Together, these findings underscore the importance of perch-site selection in predation by spiders. Nevertheless, given the small sample size, our inferences remain preliminary. Further studies with greater replication are required to evaluate the frequency, determinants, and ecological consequences of lycosid predation on odonates in Andean freshwater systems.

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Author's contributions

Fredy Palacino Rodríguez and Diego Andrés Palacino Penagos were responsible for conceptualizing, methodology, investigation, formal analysis, original draft preparation, and review and editing.

Table 1. Perch height, observation duration, environmental conditions, and spider timeout recorded during field observations.

Date	Perch height (cm)	Duration (min)	Time	Temperature (°C)	Spider timeout (min)
September 20, 2021	10.8	13.2	11:01	22.0	5.5
December 18, 2021	17.1	8.7	11:13	21.9	5.7
December 27, 2021	12.2	11	12:05	22.8	5.6
January 08, 2022	13.7	12.2	12:17	23.5	5.1
January 11, 2022	14	11	12:01	21.7	5.9
January 23, 2022	11.4	8.8	11:04	21.8	6.1
January 25, 2022	8	14.5	11:32	23.1	6.2
January 29, 2022	8.9	16.4	13:03	21.2	5.8
February 04, 2022	10	13.6	13:14	22.3	5.7
February 07, 2022	14.5	11.8	13:47	23.3	5.5
February 11, 2022	14.5	14.3	12:55	22.2	5.5
February 17, 2022	14.5	14.2	13:13	23.7	5.8
February 21, 2022	12.7	15.7	11:52	21.4	5.2
Average	12.31	12.72	-	22.37	5.66
Standard Deviation	±2.63	±2.41	-	±0.82	0.31

Table 2. Generalized linear models evaluating the effects of perch height (Perch), time of day (Time), and environmental temperature (Temperature) on attack duration.

Model	df	AICc
Perch + Time + Temperature	14	- 1012.93
Perch + Time	14	- 1012.93
Time + Temperature	14	-1006.86
Time	14	-1006.86
Perch + Temperature	4	68.12
Temperature	3	67.37
Perch	3	63.80

Note. Degree freedom = df; The best-supported model included Perch and had the lowest AICc.

Figure 1. Spider and dragonfly species recorded during observations at Club Náutico El Muña.



Note. A) Dorsal habitus of *Tropicosa thorelli*; B) male of *Rhionaeschna marchali*.

Figure 2. Male of *R. marchali* floating on the water after being bitten by *T. thorelli*.



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