

Brief Communication / Comunicación Breve

Cannibalistic behavior in *Rhopalurus laticauda* Thorell, 1876 and *Tityus silvestris* Pocock, 1897 (Scorpiones: Buthidae) under captivity in the extreme north of the Brazilian Amazon

Conducta canibalística de *Rhopalurus laticauda* Thorell, 1876 y *Tityus silvestris* Pocock, 1897 (Scorpiones: Buthidae) en condiciones de cautiverio en el extremo norte de la Amazonía brasileña

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Abstract. Scorpions are predators, with diets ranging from insects to other arachnids. Despite this, their predatory habits, especially in the Brazilian Amazon, are still poorly understood. This study documents, for the first time, cannibalistic events in the species *Rhopalurus laticauda* Thorell, 1876 and *Tityus silvestris* Pocock, 1897, both species found in Roraima. The first species is more common in open areas known as *lavrado*, while the second inhabits humid forests. During the study, we observed that, in most cases, the individuals involved in cannibalistic acts were of similar sizes. Only in one case, an adult preyed on a juvenile. These interactions, frequently associated with territorial disputes and for food, culminated in confrontations in which the weaker individual was subjugated. Our data, obtained under controlled captive conditions, revealed an aggressive and competitive behavior among scorpions of these species. It is important to highlight that similar behaviors were recorded in videos collected during field expeditions, suggesting that cannibalism also occurs in natural environments. The subjugated animals are consumed entirely in many cases, and in others, only parts of the consumed animals were found. These results contribute significantly to the understanding of the population dynamics of scorpions in the Amazon, indicating that intraspecific competition may be an important factor in the regulation of these populations.

Key words: Amazon Forest; antagonistic interaction; *lavrado*; Roraima.

Resumen. Los escorpiones son depredadores con dietas que varían desde insectos hasta otros arácnidos. A pesar de esto, sus hábitos depredadores, especialmente en la Amazonía brasileña, aún son poco comprendidos. Este estudio registra, por primera vez, eventos de canibalismo en las especies *Rhopalurus laticauda* Thorell, 1876 y *Tityus silvestris* Pocock, 1897, ambas encontradas en Roraima. La

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primera especie es más común en áreas abiertas conocidas como lavrados, mientras que la segunda habita en bosques húmedos. Durante el estudio, se observó que, en la mayoría de los casos, los individuos involucrados en actos de canibalismo eran de tamaños similares. Solo en un caso, un adulto depredó a un juvenil. Estas interacciones, frecuentemente asociadas con disputas territoriales y por alimento, culminaron en confrontaciones en las que el individuo más débil fue subyugado. Los datos obtenidos en condiciones controladas de cautiverio revelaron un comportamiento agresivo y competitivo entre los escorpiones de estas especies. Es importante destacar que comportamientos similares fueron registrados en videos recopilados durante expediciones de campo, lo que sugiere que el canibalismo también ocurre en ambientes naturales. Los animales subyugados son consumidos en su totalidad en muchos casos, y en otros, solo se encontraron partes de los animales consumidos. Estos resultados contribuyen significativamente a la comprensión de la dinámica poblacional de los escorpiones en la Amazonía, indicando que la competencia intraespecífica puede ser un factor importante en la regulación de estas poblaciones.

Palabras clave: Interacción antagónica; lavado; Roraima; selva amazónica.

Cannibalism represents an ecological interaction wherein individuals are eliminated due competition for resources (Fox 1975). In such interactions, one individual kill and consumes another of the same species, often occurring during conflicts for survival or reproduction (DeVore *et al.* 2021; Persson *et al.* 2000). By definition, cannibalism is the practice of an individual killing another of the same species to partially or completely feed on the victim's body parts (Elgar *et al.* 1992).

Scorpions are generally sedentary and territorial, often displaying aggressive behaviors towards other scorpions or their offspring (Martins *et al.* 2024; Moreira *et al.* 2022; Polis 1990). Their nocturnal behavior and cryptic coloration make it difficult to observe them preying on other animals. This particularly truth for the Amazon species, where the feeding habits knowledge is limited (Almeida *et al.* 2022; Battirola *et al.* 2015; Lourenço *et al.* 2006; Martins *et al.* 2024). Despite this, in recent years scorpion interactions with other taxa have been described (Almeida *et al.* 2022; Battirola *et al.* 2015; Martins *et al.* 2024).

Battirola *et al.* (2015) recorded to *Tityus strandi* Werner, 1939 scorpion preying on an *Ancylometes rufus* Walckenaer, 1837 spider in the southern Amazon. An unusual predation event involving a cricket species, *Hyperomerus* sp., preying on a *Chactopsis* sp. scorpion was documented in the western Brazilian Amazon (Almeida *et al.* 2022). More recently, four cases of cannibalism involving *T. metuendus* Pocock, 1897, were reported in Brazilian Amazon (Martins *et al.* 2024). These cases provide a better understanding of scorpions from Amazon forest feeding habits.

In this study we report events of intra-specific predation in an *ex-situ* environment, involving two species occurring in the state of Roraima, the northernmost state of Brazil placed inside the Amazon forest: *Rhopalurus laticauda* Thorell, 1876, and *Tityus silvestris* Pocock, 1897. *Rhopalurus laticauda* is a mid-scorpion species with males measuring between 40 and 45 mm and females from 45 to 50 mm (Esposito *et al.* 2017). This species may be found in open grasslands and remaining forest areas at the northernmost tip of the Amazon forest, where it mainly hides in cracks in the soil or under leaf litter (Esposito *et al.* 2017; Teruel and Tietz 2008). On the other hand, *T. silvestris* is a small scorpion, measuring between 25 to 45 mm in length (Braga 2010). This scorpion mainly inhabits tropical forests and may be found in elevated regions inhabiting the leaf litter layers (Braga 2010). Recently, *T. silvestris* individuals were found living on plants, such as açai palms and tucumã (Martins *et al.* 2022). Additionally, *T. silvestris*, along with *T. metuendus* and *T. obscurus* (Gervais, 1843), are responsible for the majority of severe envenomation cases in the Amazon region (Martins *et al.* 2021).

Individuals of *R. laticauda* and *T. silvestris* were collected at the Federal University of Roraima, Cauamé Campus (2°52'26" N, 60°43' 57" W), in the municipality of Boa Vista – Roraima, Brazil, which stands out for its typical savanna vegetation. The animals were fed weekly with *Blaptica dubia* Serville, 1839 cockroaches nymphs, *Tenebrio molitor* Linnaeus, 1758 beetle larvae, or annatto beetle larvae *Stator* sp. for the offsprings. To prevent overpopulation, 30 animals were kept per box (H: 25.0 cm; L: 41.0 cm; W: 29.0 cm). All observations for both *R. laticauda* and *T. silvestris* were conducted in the vivarium at the Federal University of Roraima (UFRR), in Boa Vista, Roraima, Brazil. The maintenance of the animals in captivity was previously approved by the Authorization and Information System on Biodiversity - SISBIO no. 88548-4.

The first recorded instance of cannibalism occurred in July 2023, at 2:47 PM. Upon opening the enclosure in the research group's vivarium, a female *R. laticauda* was found feeding on the prosoma of another adult scorpion (Fig. 1A). The second case was documented in February 2024, at 7:00 PM, when a female of the same species was observed consuming two juveniles (Fig. 1B). An even more unusual event was recorded in March 2024, at 10:30 AM, when a juvenile *R. laticauda* was seen preying on another juvenile of similar size (Fig. 1C). Additionally, in April 2024, at 7:30 PM, during a field activity, an individual of *T. silvestris* was captured and placed together with other specimens. Subsequently, a female of this species was observed completely consuming another individual (Fig. 1 D).



Figure 1. Scorpion cannibalistic behavior. **A.** Adult female *Rhopalurus laticauda* preying on another adult. **B.** Adult female *Rhopalurus laticauda* preying on its offspring. **C.** Juvenile *R. laticauda* preying on another juvenile. **D.** Adult female *Tityus silvestris* feeding on a smaller individual of the same species.
/ **Figura 1.** Comportamiento canibalístico de los escorpiones. **A.** Hembra adulta de *Rhopalurus laticauda* cazando a otro adulto. **B.** Hembra adulta de *R. laticauda* cazando a su descendencia. **C.** Juvenil de *R. laticauda* cazando a otro juvenil. **D.** Hembra adulta de *Tityus silvestris* alimentándose de un individuo más pequeño de la misma especie.

Cannibalism is a disharmonious interaction in which individuals feed on others of their own species. This practice can be classified according to the degrees of relatedness among the individuals involved: intrauterine, filial, fraternal, sexual, matrifagous, or pathological (Wille Lima 2024). Observations of scorpions in captivity have revealed various types of cannibalism (Wille Lima 2024). Among scorpions filial cannibalism (Fig. 2A) is common on parturient scorpion females and has been documented in species such as *Tityus serrulatus* Lutz & Mello, 1922, and *Tityus stigimurus* Thorell, 1876 (Scorpiones: Buthidae) (Martins *et al.* 2008; Wille Lima 2024). Furthermore, fraternal cannibalism also occurs in scorpions between siblings of the same or different generations, which facilitates a beneficial reduction in population size for survivors (Fig. 2B).

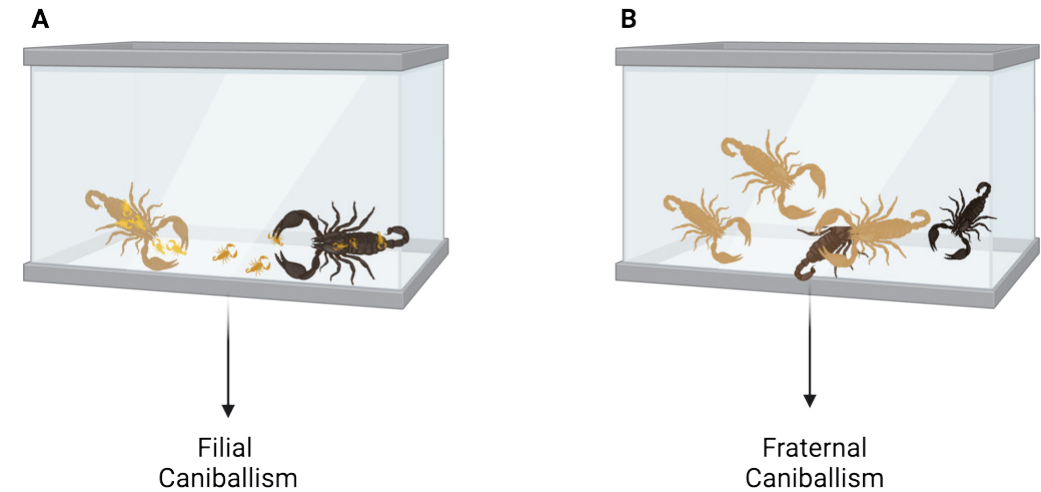


Figure 2. A. Filial cannibalism behavior in scorpions. **B.** Fraternal cannibalism behavior in scorpions. / **Figura 2. A.** Comportamiento de canibalismo filial en escorpiones. **B.** Comportamiento de canibalismo fraternal en escorpiones.

As an example of cannibalism, we can reference fish species from the Amazon Basin: the Surubim *Pseudoplatystoma fasciatum* Linnaeus, 1766 (Siluriformes: Pimelodidae) and the Pirarucu *Arapaima gigas* Schinz, 1822 (Osteoglossiformes: Osteoglossidae). Fraternal cannibalism in *P. fasciatum* has been observed in both larval and juvenile stages, a behavior promoted by increased population density and competition for space. However, *A. gigas* displayed fraternal cannibalism only under confinement conditions, even in the absence of food competition. Stomach content analyses revealed that the prevalence of cannibalism was around 50-60% among larvae (Wille Lima 2024). Based on these findings, we can extrapolate both filial and fraternal cannibalism to our observations of scorpions, which were kept in captivity — a condition that favors such behaviors. Notably, both adults and offspring were preyed upon, likely due to competition for space, food, and mates. Indeed, we have observed *R. laticauda* engaging in fights over food and territorial disputes, whereas territorial competition likely explains cannibalism in *T. silvestris*.

The issue of population density control has been noted by other researchers. In an experimental study, cannibalism among scorpions was found to be lower between individuals of similar body size and was mitigated by habitat complexity when animals exhibited asymmetric sizes (Moreira *et al.* 2022).

The scorpions are generally classified as having low metabolic rates (Lighton *et al.* 2001; Van Aardt *et al.* 2016). However, some studies have shown that metabolic rates are influenced by increasing population density, which can lead to an increased likelihood of

cannibalism (Lighton *et al.* 2001). Moreover, previous research has highlighted cannibalism as a significant regulatory mechanism for scorpion populations, accounting for 30% of consumed biomass (Polis 1979, 1980, 1981), which makes it a major cause of mortality among juvenile scorpion populations, particularly under laboratory conditions (Brenes *et al.* 2016; Nagaraj *et al.* 2015).

Thus, cannibalism, influenced by factors such as population density, competition for resources, and metabolic rates, plays a crucial role in regulating scorpion populations. Understanding these dynamics is essential for effective population management and conservation efforts, particularly in controlled environments where such behaviors are more pronounced.

The findings of this study indicate that both *R. laticauda* and *T. silvestris* exhibit cannibalistic behavior, preying on smaller individuals. Additionally, it was observed that both *R. laticauda* adults and juveniles may prey on conspecifics of similar size. Although these cannibalism events for these scorpion species were from captivity, they highlight the need for further investigation in natural areas. Such behaviors should be interpreted with caution and considered in future studies to better understand their ecological and evolutionary implications.

Author Contributions

GM-d-S, MBP: Conceptualization. **GM-d-S, GaM-d-S, TML, AMR, SRJ, EFS:** Data curation, investigation, methodology. **MBP, FAC:** Project administration and supervision. **GM-d-S, GaM-d-S, TML, AMR, SRJ, FAC, EFS, AS, AFAL, MBP:** Writing, review & editing.

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