Brief Communication / Comunicación Breve

Cannibalism in *Tityus metuendus* Pocock, 1897 (Scorpiones: Buthidae) from the Brazilian Amazon

Canibalismo en *Tityus metuendus* Pocock, 1897 (Scorpiones: Buthidae) de la Amazonia brasileña

Jonas G. Martins[1], Marllus R. N. Almeida[2], Rudi E. L. Procópio[3], André F. A. Lira[4]*

[1]*Instituto Nacional de Pesquisas da Amazônia, Programa de Pós-Graduação em Genética, Conservação e Biologia Evolutiva, Manaus, Brasil.* [2]*Universidade Federal do Acre, Laboratório de Geoprocessamento Aplicado ao Meio Ambiente Cruzeiro do Sul, Brasil.* [3]*Universidade Federal do Amazonas, Programa de Pós-Graduação em Biotecnologia e Recursos Naturais da Amazônia, Manaus, Brasil.* [4]*Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México, Ciudad de México, México.* *andre.lira@st.ib.unam.mx**

ZooBank: urn:lsid:zoobank.org:pub:C10FAA10-01C6-4017-815F-2404817EE766
https://doi.org/10.35249/rche.50.1.24.08

Abstract. Scorpions are an important predator group in the habitats where they live, due to their voracity. However, their predatory habits are not well recorded, particularly in Amazonian species. Here we report four intraspecific predation events involving *Tityus metuendus* Pocock, 1987. In all cases, larger individuals acted as predators of smaller ones. These are the first reports of cannibalism involving scorpions in the Brazilian Amazon. Our findings are important to allow a better understanding of intraspecific interactions in tropical scorpion assemblages.

Key words: Antagonistic interaction; arachnids; tropical forest.

Resumen. Debido a su voracidad los escorpiones son un grupo importante de depredadores en los hábitats donde viven. Sin embargo, sus hábitos depredadores no están bien registrados, especialmente en especies amazónicas. Aquí se informan cuatro eventos de depredación intraespecífica que involucran a *Tityus metuendus* Pocock, 1987. En todos los casos, los individuos de mayor tamaño actuaron como depredadores de los más pequeños. Estos son los primeros registros de canibalismo en escorpiones de la Amazonía brasileña. Estos hallazgos son importantes porque permiten una mejor comprensión de las interacciones intraespecíficas en los ensambles de escorpiones tropicales.

Palabras clave: Aracnídos; bosque tropical; interacción antagónica.

Cannibalism is defined as an ecological interaction where individuals are eliminated because of their lower aptitude or competition for resources (Fox 1975). In this interaction, an individual kills and feeds on another individual of the same species, which can occur while fighting for survival or reproduction (*e.g.*, Persson *et al*. 2000; DeVore *et al.* 2021). According to Polis (1980), this ecological interaction may contribute to population balance in the long term. For example, cannibalism regulates the predator population size, allowing for their maintenance in seasons with low prey availability (Wise 2006; Oliveira *et al*. 2022). This interaction has been reported in several arthropod groups (*e.g.*, Wise 2006; Alabi *et al.* 2008; Clark *et al*. 2021), particularly in scorpions (Polis 1980; Moreira *et al*. 2022).

Received 17 January 2024 / Accepted 18 February 2024 / Published online 31 March 2024
Responsible Editor: José Mondaca E.

Scorpions are considered generalist predators, preying on a wide range of invertebrates, and even small vertebrates (Polis 1990). These arachnids typically have sedentary and territorial habits, being aggressive to other scorpion species or their juveniles (Polis 1990; Moreira *et al*. 2022). Due to their cryptic habits, field interaction reports of scorpions with other animals are relatively scarce in the literature, particularly in the Amazon region (Lourenço *et al*. 2006; Battirola *et al*. 2015; Almeida *et al*. 2022). For example, in the southern Brazilian Amazon, an individual of *Tityus strandi* (Werner, 1939) was found preying on the spider *Ancylometes rufus* (Walckenaer, 1837) (Battirola *et al*. 2015). Recently, Almeida *et al*. (2022) described an unusual predation event where a *Hyperomerus* Redtenbacher, 1891 katydid was found preying on a *Chactopsis* Kraepelin, 1912 scorpion in the western Brazilian Amazon. These reports are useful for comprehension of food web dynamics in natural environments. Here we describe four cases of cannibalism involving individuals of *Tityus metuendus* Pocock, 1897 in the Brazilian Amazon.

Tityus metuendus is a large (80-90 mm) blackish-brown scorpion that is widespread in rainforest habitats, especially in the western Amazon (Lourenço 2011), typically found in leaf litter strata and palm trees (reviewed in Martins *et al*. 2021). Furthermore, *T. metuendus* together with *T. obscurus* (Gervais, 1843) and *T. silvestris* Pocock, 1897 are responsible for most cases of severe envenomation in the Amazon region (Martins *et al*. 2021).

The cannibalism events reported here were observed during a field study in 2019-2023 in an urban forest fragment on the campus of Universidade Federal do Estado do Amazonas (3°05’54’’S, 59°58’19’’W), in rural zone (3°01’15.4’’S, 60°03’50.9’’W), in Manaus, Amazonas state, and an upland (‘terra firme’) forest area located within the Mogno State Forest (7°50’27’’S, 71°48’46’’W), in the municipality of Tarauacá, Acre state, Brazil. Voucher specimens were deposited in the invertebrate collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus. Our first record (September 2019) occurred at night (19:00-21:00 h) which we observed an adult male on the leaf litter preying on the prosoma of a subadult (Fig. 1A). In our second record (December 2019), we observed an adult female eating the mesosoma of an adult male in the morning (08:00-09:00 h) beneath a palm tree leaf (Fig. 1B). Both cannibalism events were recorded in an urban forest fragment on the campus of Universidade Federal do Estado do Amazonas. The third record (July 2021) occurred during the night (19:00-21:00 h) in Tarauacá, Acre state, where we observed an adult male on a tree trunk (ca. 100 cm in height) preying on the pedipalp of a juvenile of its species (Fig. 1C). In the last record, we found an adult male eating the prosoma of a juvenile at night (22:00-23:00 h) in leaf litter (Fig. 1D).

In all these episodes, larger *T. metuendus* individuals acted as predators of smaller ones. Previous studies have reported that intra and interspecific relationships in scorpions are size-mediated, with the larger individuals preying on smaller ones (*e.g*., Moreira *et al*. 2022; Toprak *et al*. 2022). In an experimental study, Moreira *et al*. (2022) found that cannibalism in scorpions was lower between individuals of similar body size and was mitigated by habitat complexity when animals possess asymmetric size. In addition, scorpions are typically classified as having a low metabolic rate (Lighton *et al*. 2001; van Aardt *et al*. 2016). Thus, lower metabolic rates result in increases in population density, which can increase the probability of cannibalism (Lighton *et al*. 2001). Previous studies have shown that cannibalism is an important regulatory mechanism for scorpion populations, accounting for approximately 30% of the ingested biomass (Polis 1979, 1980, 1981). This interaction is a major cause of mortality in small-sized individuals (Polis 1979; Polis *et al*. 1981). Our records may suggest that larger *T. metuendus* individuals often feed on smaller ones, potentially serving as a mechanism to regulate the population size of this scorpion species. However, it is important to note that these findings are based on limited field observations and should be interpreted with caution. In this way, this hypothesis needs to be tested in future studies of scorpion food dynamics in Amazon region.

Figure 1. Cannibalism records involving the scorpion *Tityus metuendus* in Brazilian Amazon. **A.** Adult male individual preying on a subadult in an urban forest fragment, state of Amazonas. **B.** Adult female preying on an adult male in an urban forest fragment, state of Amazonas. **C.** Adult male individual preying on a juvenile in Mogno State Forest, state of Acre. **D.** Adult male individual preying on a juvenile in rural zone, state of Amazonas. / **Figura 1.** Registros de canibalismo que involucran al escorpión *Tityus metuendus* en la Amazonia brasileña. **A.** Macho adulto depredando a un subadulto en un fragmento de bosque urbano, estado de Amazonas. **B.** Hembra adulta depredando a un macho adulto en un fragmento de bosque urbano, estado de Amazonas. **C.** Macho adulto depredando a un juvenil en el estado de Mogno Bosque, estado de Acre. **D.** Individuo macho adulto depredando a un juvenil en zona rural, estado de Amazonas.

Author Contributions

JM: Investigation, resources, data curation, writing - review & editing. **MA:** Investigation, resources, data curation, writing - review & editing. **RP:** Resources, funding acquisition, writing - review & editing. **AL:** Conceptualization, validation, visualization, writing - original draft.

Acknowledgements

We thank the Dirección General de Asuntos del Personal Académico (DGAPA) postdoctoral fellowship from the Universidad Nacional Autónoma de México to AFAL. We also thank the anonymous reviewers for their valuable comments.

Literature Cited

Alabi, T., Michaud, J.P., Arnaud, L. and Haubruge, E. (2008) A comparative study of cannibalism and predation in seven species of flour beetle. *Ecological Entomology*, *33*: 716-726. https://doi.org/10.1111/j.1365-2311.2008.01020.x

Almeida, M.R.N., Nascimento, J.A.F., Machado, E.O. and Lira, A.F.A. (2022) Once a prey, now a predator: an unusual record of a scorpion (Scorpiones: Chactidae) predated by a katydid (Orthoptera: Tettigoniidae) in the western Brazilian Amazon. *Acta Amazonica*, *52*: 229-231. https://doi.org/10.1590/1809-4392202200151

Battirola, L.D., Rodrigues, D.J., Batistella, D.A., da Silva, A.P.S. and Brescovit, A.D. (2015) A case of predation on *Ancylometes rufus* (Walckenaer, 1837) (Araneae, Ctenidae) by *Tityus strandi* (Werner, 1939) (Scorpiones, Buthidae) in southern Amazonia. *Acta Biológica Paranaense*, *44*: 145-151. https://doi.org/10.5380/abpr.v44i1-4.44120

Clark, C., Hossie, T.J. and Beresford, D.V. (2021) Density-dependent cannibalism in dragonfly nymphs (Odonata: Anisoptera) overwintering in temperate freshwater ponds. *Environmental Entomology*, *50*: 1483-1489. https://doi.org/10.1093/ee/nvab097

DeVore, J.L., Crossland, M.R., Shine, R. and Ducatez, S. (2021) The evolution of targeted cannibalism and cannibal-induced defenses in invasive populations of cane toad. *Proceedings of the National Academy of Sciences*, *118*: 1-8. https://doi.org/10.1073/pnas.2100765118

Fox, L.R. (1975) Cannibalism in natural populations. *Annual Review of Ecology and Systematics*, *6*: 87-106. https://doi.org/10.1146/annurev.es.06.110175.000511

Lighton, J.R., Brownell, P.H., Joos, B. and Turner, R.J. (2001) Low metabolic rate in scorpions: implications for population biomass and cannibalism. *Journal of Experimental Biology*, *204*: 607-613. https://doi.org/10.1242/jeb.204.3.607

Lourenço, W.R. (2011) The distribution of noxious species of scorpions in Brazilian Amazonia: the genus *Tityus* C. L. Koch, 1836, subgenus *Atreus* Gervais, 1843 (Scorpiones, Buthidae). *Entomologische Mitteilungen*, *15*: 287-301.

Lourenço, W.R., Brescovit, A.D., Rheims, C.A. and Cloudsley-Thompson, J.L. (2006) First record of a crab spider (Thomisidae) preying on a scorpion. *Boletín de la Sociedad Entomológica Aragonesa*, *39*: 404-405.

Martins, J.G., Santos, G.C., Procópio, R.E.L., Arantes, E.C. and Bordon, K.C.F. (2021) Scorpion species of medical importance in the Brazilian Amazon: a review to identify knowledge gaps. *Journal of Venomous Animals and Toxins including Tropical Diseases*, *27*: 1-32. https://doi.org/10.1590/1678-9199-JVATITD-2021-0012

Moreira, M.O.M., Araújo, V.L.N., Foerster, S.Í.A., Moura, G.J.B. and Lira, A.F.A. (2022) Relationship between body size and habitat heterogeneity on cannibalism and intraguild predation in scorpions. *Biologia*, *77*: 2867-2873. https://doi.org/10.1007/s11756-022-01154-z

Oliveira, C.M., Silva-Torres, C.S.A., Torres, J.B. and De La Pava, N. (2022) Cannibalism and intraguild predation between endemic and introduced coccidophagous lady beetles (Coleoptera: Coccinellidae). *Austral Entomology*, *61*: 225-235. https://doi.org/10.1111/aen.12589

Persson, L., Byström, P. and Walstöm, E. (2000) Cannibalism and competition in Eurasian perch: population dynamics of an ontogenetic omnivore. *Ecology*, *81*: 1058-1071. https://doi.org/10.2307/177178

Polis, G.A. (1979) Prey and feeding phenology of the desert sand scorpion *Paruroctonus mesaensis* (Scorpionida: Vaejovidae). *Journal of Zoology*, *188*: 333-346.

Polis, G.A. (1980) The effect of cannibalism on the demography and activity of a natural population of desert scorpions. *Behavioral Ecology and Sociobiology*, *7*: 25-35. https://doi.org/10.1007/BF00302515

Polis, G.A. (1981) Evolution and dynamics of intraspecific predation. *Annual Review of Ecology, Evolution, and Systematics, 12*: 225-251. https://doi.org/10.1146/annurev.es.12.110181.001301

Polis, G.A. (1990) *The biology of scorpions*. Stanford University Press, Stanford, 587 pp.

Polis, G.A., Sissom, W.D. and McCormick, S.J. (1981) Predators of scorpions: field data and review. *Journal of Arid Environments, 4*: 309-326. https://doi.org/10.1016/S0140-1963(18)31477-0

Toprak, S., Kurt, R. and Yagmur, E.A. (2022) First report of intraguild predation in scorpions (Scorpiones: Buthidae) from Turkey. *Euscorpius, 363*: 1-4.

van Aardt, W.L., le Roux, J.M., Lindeque, J.Z., Mason, S. and Louw, R. (2016) The effect of temperature on the respiration and metabolism of the African burrowing scorpion (*Opistophthalmus latimanus*). *Comparative Biochemistry and Physiology Part D: Genomics and Proteomics, 20*: 50-56. https://doi.org/10.1016/j.cbd.2016.07.003

Wise, D.J. (2006) Cannibalism, food limitation, intraspecific competition, and the regulation of spider populations. *Annual Review of Entomology*, *51*: 441-465. https://doi.org/10.1146/annurev.ento.51.110104.150947