

# BIOLOGICAL CURIOSITIES ON THE NATURAL HISTORY OF LIZARDS FROM VENEZUELA: SAUROPHAGY OF *GONATODES ALBOGULARIS* (DUMÉRIL & BIBRON, 1836) BY *TROPIDURUS HISPIDUS* (SPIX, 1825), AND ATTACK OF *GYMNOPHTHALMUS SPECIOSUS* (HALLOWELL, 1861) BY A LARVA OF *MYRMELEON* SP. (NEUROPTERA)

CURIOSIDADES BIOLÓGICAS SOBRE LA HISTORIA NATURAL DE LAGARTOS DE VENEZUELA: SAUROFAGIA EN *GONATODES ALBOGULARIS* (DUMÉRIL & BIBRON, 1836) POR *TROPIDURUS HISPIDUS* (SPIX, 1825), Y ATAQUE DE *GYMNOPHTHALMUS SPECIOSUS* (HALLOWELL, 1861) POR UNA LARVA DE *MYRMELEON* SP. (NEUROPTERA)

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**Resumen.** – La información documentada sobre las dietas de las lagartijas ha contribuido a una mejor comprensión de la ecología de las especies, las estrategias y las interacciones depredador-presa. Para nuestro país, la información sigue siendo muy discreta. Aquí se reportan dos casos de interacciones anecdóticas: en primer lugar, la depredación de *Gonatodes albogularis* por *Tropidurus hispidus*, y el segundo caso, la ocurrencia de una lagartija de hojarasca *Gymnophthalmus speciosus* atacada por un invertebrado Neuroptera en su estado larvario del género *Myrmeleon*.

**Palabras claves.** – Ecología, interacciones depredador-presa, norte de Suramérica, reptiles.

**Abstract.** – Documented information on lizard diets have contributed to a better understanding of species ecology, strategies, and predator-prey interactions. For Venezuela, the information continues to be very discreet. Two cases of interactions are anecdotally reported here: firstly, the predation of *Gonatodes albogularis* by *Tropidurus hispidus*, and secondly, the occurrence of a leaf litter lizard *Gymnophthalmus speciosus* subjugated by a Neuroptera of the genus *Myrmeleon* in its larval stage.

**Key words.** – Ecology, northern South America, predator-prey interactions, reptiles.

## Saurophagy

Knowledge about the predator-prey relationship is a fundamental topic to understand the magnitude and scale of the ecological processes immersed in these interactions, be it through trophic ecology, population (natality-mortality), trajectories of the flows of matter and energy in ecosystems (Abrams, 2000). In the Squamata, lizards-amphisbaenids

and snakes are parts of the continuous or occasional diet of countless vertebrates or invertebrates (Greene, 1988; Vitt & Caldwell, 2009; Natera-Mumaw et al., 2015). Unlike ophiophagy which is considered a dietary specialization (e.g. *Micrurus*; Roze, 1996), saurophagy is an opportunistic nature, although apparently common among many lizard species, being an

increasingly documented (Siqueira & Rocha 2008; Zanchi et al., 2012; Passos et al., 2016; Pergentino et al., 2017).

The genus *Tropidurus* Wied, 1825 is constituted of 28 spp. (Uetz et al., 2023), which are known to be ambush foragers with generalist and opportunistic feeding habits (Kolodiuk et al., 2010). In general, its diet is mainly based on invertebrates (Van Sluys et al., 2004; Gomides et al., 2013; Siquiera et al., 2013), it also consumes fruits (Pérez et al., 2009; Gomides et al., 2013) and other small vertebrates such as birds (Guedes et al., 2017), mammals (Gasparini & Peloso 2007), amphibians (Costa et al., 2010; Beltrão-Mendes, 2017) and reptiles, like snakes and lizards (Pergentino et al., 2017; Salcedo et al., 2022).

Our sighting occurred in the city of Valle de la Pascua, Leonardo Infante municipality, Guárico state, north of the Orinoco River (9°13'1.83" N; 65°58'46.01" W, 185 m a.s.l.), on March 2023 at 10:30 AM (approximately 28 °C), where an adult individual of *Tropidurus hispidus* (Spix, 1825) was perched on the trunk of a tree, beginning to engulf an adult male of *Gonatodes albogularis* (Duméril & Bibron, 1836). Part of the prey body were completely inside the lizard's mouth, close to the forelimbs and being able to observe the head of a male (Fig. 1). In Venezuela, the diversity of lizards is significant with ~162 species (Rivas et al., 2012; Esqueda *in prep.*), although documented information regarding saurophagy be scarce. Only two documented cases are known, *Hemidatylys mabouia* (Rojas-Runjaic et al., 2006) and *Hemidatylys frenatus* (Salcedo et al., 2022), both preyed on by *T. hispidus*.

Physiological conditions and ecological context are drivers that constantly modify behavioral responses with respect to predator-prey interactions. Today, anthropogenic biomes (antromes) have largely replaced natural, pristine environments in the most biodiverse regions of the planet, nearly twice the global land area (Ellis, 2013). These novel landscapes take the form of multifunctional mosaics where the used areas and those where the environments have not undergone alteration are mixed, and consequently we can contemplate biotic communities (e.g. native and/or foreign reptiles) whose dimension of predator-prey interactions are indeterminate and less explored in South American species. Many anthropic landscapes are characterized by a simplified resource structure and a general loss of ecological niches, where colonizing or remaining taxa are often exposed to novel selective pressures (Tews et al., 2004), being then the antromes ecological novelties that can change the spatial and temporal overlap between predators and prey (Guiden et al., 2019).

In this respect, *T. hispidus* (predator) and *G. albogularis* (prey) are very frequent lizards in Venezuelan antromes (*obs. pers.*, Luis Felipe Esqueda; Andrade, 2019), taking advantage of either human constructions or existing vegetation that may or may not combine with different elements (e.g., exotic flora). In



**Figure 1.** Predation of *Gonatodes albogularis* by an adult of *Tropidurus hispidus*. Photo: David Briceño©.

**Figura 1.** Depredación de *Gonatodes albogularis* por un adulto de *Tropidurus hispidus*. Foto: David Briceño©.

addition, both species are heliothermic, generalists as far as diet is concerned, and ambush predators. To *G. albogularis* there is a marked sexual dimorphism associated with the color pattern, where females have a light brown back and head with dark spots, while in males there is a very striking reddish coloration on the head and anterior third of the body. In historical environments (non-anthropogenic) such as a forest, both patterns are favored by landscape because it facilitates camouflage; contrarily case occurs with the antromes, which decrease crypsis in males. On the other hand, such environments are strongly seasonal, which leads to renouncing anti-predator behaviour and favouring foraging and reproduction. So, organisms living in urban habitats face multiple challenges, including a highly altered ecosystem with different types of perches and refuge sites. According to optimal escape theory (Ydenberg & Dill, 1986), refuge distances greatly influence escape responses. Heliothermic lizards are known to alter their activity and exposure rate by changing the use of their microhabitat when faced with potential predation risks (Greene, 1988; Carrascal et al., 1992). However, this change may benefit a lizard by making it more to visually oriented predators (Schwarzkopf & Shine, 1992), just as it could occur with *T. hispidus*.

Both saurophagy and cannibalism seem to be frequent in members of the genus *Tropidurus* and their occurrence is mostly associated with these ecosystems called antromes (Kokubum & Lemos, 2004; Pergentino et al., 2017; Ventura-Reis et al., 2017; Mascarenhas-Junior et al., 2021; Salcedo et al., 2022). Although a positive relationship between body size and niche breadth is a general pattern in macroecology, there is evidence that predators have a decrease in dietary niche breadth with increasing size (Beckerman et al., 2006), as has been reported in tropidurid and teiids lizards (Costa et al., 2008), which suggests that consuming small prey in these highly seasonal and anthropized environments does not seem to be an optimal feeding strategy.

### Subjugation by an invertebrate

At present, one of the most fascinating, transcendent and consideration aspects in ecological studies is predator-prey interactions (Berryman, 1992). Its development and discussion have been mainly subordinated to the central role of the search for food in the life of predators and their prey, and the dynamics of predation at the population level, due to the anthropogenic modification of natural ecosystems (Muhly et al., 2011; Guiden et al., 2019). In this context, the predation of vertebrates by invertebrates has classically been little explored and, therefore, underestimated, despite the fact that many invertebrates (e.g., arthropods) could be important predators of small vertebrates

(Nordberg et al., 2018; Reyes-Olivares et al., 2020; Valdez, 2020).

In insects, there is a wide variety of strategies for capturing and subjugating their prey. For the same species, adults and/or larvae can adopt different predatory strategies (Mogi, 2007; Mukherjee & Heithaus, 2013). For example, the so-called larval ant lions of lacewings (Neuroptera: Myrmeleontidae), specifically members of the genus *Myrmeleon* Linnaeus, 1767 seem mostly "sit-and-wait" foragers, feeding by constructing pit traps (Lucas, 1982). In general, its diet usually consists of ants and soil arthropods (Griffiths, 1980; Heinrich & Heinrich, 1984). These larvae capture prey using their extensible long jaws, in addition to releasing venom or digestive secretions (Cohen, 1995). Although it is not very clear, the venom could derive from a maxillary gland or be involved in the alimentary canal, and its toxins would be elaborated by bacterial symbionts in the intestine. The venom contains a potent toxin with paralytic action, comparable to the peptides and alkaloids used by most arthropods to subdue their prey (Walker et al., 2018), even 130 times higher than tetrodotoxin on a molar basis (Matsuda et al., 1995).

The event occurred in a Pine plantation stand (Uverito), situated in Monagas state, Eastern part of Venezuela. A somewhat leaning tree, with the bark detached, close to its base, a specimen of *Myrmeleon* sp. in its third stage, had captured and subjugated an adult individual of *Gymnophthalmus speciosus* (Hallowell, 1861), using its long jaws (Fig. 2). Due to the lizard's flaccid position, with its front and hind limbs clearly extended, it was assumed that the Antlion larva had injected its venom (after the sighting, no follow-up was carried out because the person was working in the plantations). Ant lions present behavioral predation actions whose first movements are a quick attack followed by a hard pressure of the jaw against the victim (Napolitano, 1998). Although trap-pit construction is the best-known antlion behavior, only about one-third of all Myrmeleontid species are known to adopt this tactic (Machado et al., 2019). In fact, most larvae are passive or active predators that capture their prey without the use of traps, and these can be found in a variety of microhabitats, including under sand or other debris, tree holes, caves, rock surfaces (Stang, 1980; Mansell, 1999).

Unraveling food webs can be quite challenging, considering the time and resources involved in studying a particular group of organisms (e.g. reptiles). However, understanding such interactions becomes essential in the ecology of communities and populations, even more, when anthropogenic activities



**Figure 2.** Attack by a *Myrmeleon* larva (Neuroptera) on an adult of *Gymnophthalmus speciosus*. Photo: Juan Perdomo©.

**Figura 2.** Ataque de una larva de *Myrmeleon* (invertebrado) sobre un individuo adulto de *Gymnophthalmus speciosus*. Foto: Juan Perdomo©.

grow and intensify their effect on natural ecosystems. Important knowledge gaps in this regard exist for terrestrial systems, especially the role of invertebrates as predators of small ectothermic vertebrates. Our incidental and anecdotal finding, as far as we know, is the first record of a *Myrmeleon* sp. larvae attacking on a leaf litter lizard however since no follow up was perform we cannot confirm the predation event, although it is very likely to have happened. It is also important to emphasize that this event should be viewed as opportunistic, as it could have started as a defense mechanism; it is important to stress that *Myrmeleon* larvae are capable of modulating attack kinematics with respect to the location of their prey. The modulation occurs mainly through angular velocity variations of the two jaws, reducing the chances of prey escape (Lambert et al., 2011).

Therefore, it is possible that attacks and predation of small-leaf litter lizards are more frequent in this group of invertebrates.

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