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PREDATION OF A YELLOW-HEADED GECKO (*GONATODES ALBOGULARIS*) BY A BROMELIAD SPIDER (*CUPIENNIUS COCCINEUS*)

DEPREDACIÓN DE UN GECO DE CABEZA AMARILLA (*GONATODES ALBOGULARIS*) POR UNA ARAÑA DE BROMELIA (*CUPIENNIUS COCCINEUS*)

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Resumen.– La diversidad de lagartijas en el Neotrópico es alta donde participan en muchas interacciones ecológicas y son componentes importantes en las cadenas alimentarias en muchos de los ambientes donde se encuentran. La familia Sphaerodactylidae es una familia altamente diversa de gecos pequeños, en su mayoría activos durante el día, con seis especies en Costa Rica, incluido el geco de cabeza amarilla, *Gonatodes albogularis*. Arañas de gran tamaño corporal, como la araña de bromelia, *Cupiennius coccineus*, son capaces de depredar a lagartijas pequeñas. Esta araña no teje telas, sino que acecha y captura sus presas directamente desde la superficie de las hojas y otras partes de las plantas, las cuales utiliza para enviar y recibir vibraciones. Reportamos el primer caso de un geco de cabeza amarilla como presa de una araña de bromelia en el Bosque Húmedo Tropical del norte de Costa Rica.

Palabras clave.– Arañas errantes, artrópodos, Bosque Húmedo Tropical, depredación, Neotrópico, Trechaleidae.

Abstract.– Lizard diversity in the Neotropics is high where they participate in many ecological interactions and are important components in food webs in many of the environments where they occur. Sphaerodactylidae is a highly diverse family of small, mostly diurnal geckos, with six species in Costa Rica, including the Yellow-headed Gecko *Gonatodes albogularis*. Large-bodied spiders, such as the Bromeliad Spider *Cupiennius coccineus* are capable of preying upon small lizards. This spider does not construct webs but ambushes and captures prey directly from the surface of leaves and other plant parts, which they use to send and receive vibrations. We report the first case of a Yellow-headed Gecko being preyed upon by a Bromelid Spider in the Tropical Wet Forest of northern Costa Rica.

Key words.– Arthropods, Neotropics, predation, Trechaleidae, Tropical Wet Forest, wandering spiders.

Tropical habitats are characterized by their high biodiversity and complex biotic interactions, such as predation (Freestone et al., 2011; Brown, 2014). Predation can be defined as the act of one organism ingesting tissues of another (previously alive) organism (Miranda et al., 2022). However, it is a complex ecological interaction that includes several stages including the location, subjugation, and ingestion of the prey (Miranda et al., 2022). It is the most important cause of mortality in natural populations, and it can happen at any life stage (Vitt & Caldwell, 2013). Predator-prey interactions are a main driver of natural selection and other aspects of community ecology and ecosystem functioning (Portalier et al., 2019; Valdez, 2020).

Lizards play key roles in ecosystems where they are prey for a wide variety of predators, including snakes, other lizards, mammals, birds, and invertebrates (Pianka & Vitt, 2006; Samia et al., 2015). A single lizard species may be preyed on by predators belonging to several taxa (Miranda et al., 2022). Lizard diversity in the Neotropics is high and lizards occupy highly diverse habitat types where they participate in food webs that involve many other species of vertebrates and invertebrates. Their diversity in the Neotropics is expressed through differences in body sizes, feeding strategies, habitat use, and demographic dynamics, resulting in lizards being involved in several ecological interactions with their prey and predators (Miranda et al., 2022).

Sphaerodactylidae is a highly diverse family consisting of some 230 species (Uetz et al., 2023) of small, mostly diurnal geckos (Leenders, 2019). There are six species of Sphaerodactylidae in Costa Rica, including the Yellow-headed Gecko *Gonatodes albogularis* (Duméril & Bibron, 1836).

Gonatodes albogularis is a common diurnal lowland lizard found from southern Mexico and Central America to northern South America, from sea level to 1,000 m elevation (Leenders, 2019). It was introduced into Florida and also occurs on adjacent islands of Colombia and western Venezuela, as well as on Cuba, Jamaica, Grand Cayman, and Hispaniola (Savage, 2002). This lizard is often seen on palms, strangler figs, or other trees with deeply creviced bark (Leenders, 2019), but also in pastures, on roadside fences, fallen logs, trash piles, and human-made structures (Savage, 2002). Natural predators of this gecko include other reptiles, mainly larger lizards and snakes, mammals, and birds (Domínguez-López et al., 2015).

Arthropods are extremely diverse in tropical habitats and are fundamental to ecosystem function and the maintenance of biodiversity (Kremen et al., 1993). Many vertebrates, e.g. lizards, birds, and bats depend on arthropods for their survival (Mooney et al., 2010). At the same time, many arthropods, including Araneae and Scorpiones (Arachnida), are carnivores (Wise, 1993; Valdez, 2020). Individuals of these two groups are frequently eaten by toads, frogs, and lizards, but in some cases they act as predators of vertebrates including some reptiles (Armas, 2001). As a result, spiders and scorpions, are both predators and prey of other organisms that form trophic webs. Several spider families contain large-bodied species capable of preying upon small vertebrates. Valdez (2020) found in his review of 1309 predatory events carried out by arthropods on vertebrates that spiders represented over half of all these events and were the main predatory arthropods for all vertebrates except birds, and the most commonly preyed on reptiles were nearly all lizards.

Wandering spiders of the Trechaleidae family may be one of the most frequent predators on small lizards in neotropical forests (Folt & Lapinski, 2017; Prémel & Torres, 2021). This family includes Banana Spiders of the genus *Cupiennius*, generally associated with plants such as bananas, heliconias and bromeliads where they construct silken retreats sallying forth after dark to hunt (Hanson & Nishida, 2016). The Bromeliad Spider *Cupiennius coccineus* F. O. Pickard-Cambridge, 1901 is one of the larger species of the genus with male body length of 22 - 26 mm and females 27 - 38 mm, however leg span can be over 100 mm (Barth & Cordes, 1998; Vetter & Hillebrecht, 2008). Both sexes have a brown background color, but the underside of the femora of the front pair of legs of the female bears conspicuous red warning coloration (Barth & Cordes, 1998; Vetter & Hillebrecht, 2008).

In Costa Rica the Bromeliad Spider has been found from lowlands close to sea level to the Central Valley, over 1,100 m a.s.l. (Barth et al., 1988). They rest hidden in rolled leaves or among the sheaths of large leaves, and wander on leaves of heliconias and broad-leaved plants that they use as a platform to hunt within the lower parts of the forest (Barth et al., 1988). The Bromeliad spider does not construct webs but ambushes and captures prey directly from the surface of leaves and other plant parts, which they use to send and receive vibrations (Barth et al., 1988). Several species of frogs and lizards has been reported as predated by *C. coccineus*, all of them in Costa Rica (Table 1). Here we report a case of an adult male Yellow-headed Gecko being consumed by this species in the tropical wet forest of northern Costa Rica. This is the first report on this specific trophic interaction.

The observation and photographs of this predatory event are from the Selva Verde lodge in northern Costa Rica (10°27'03" N, 84°04'12" W; 78 m a.s.l.; Fig. 1). Selva Verde is located in the Tropical Wet Forest (TWF), a life zone with a mean annual rainfall of about 4,000 mm (Alvarado et al., 2022). The TWF is a tall, multistratal, evergreen forest, although some canopy species are briefly deciduous. Canopy trees reach 45–55 m in height, stilt-rooted palms often are abundant in the understory, the shrub layer is 1.5–2.5 m tall, with abundant dwarf palms, and unbranched treelets and large broad-leaved herbs are occasionally present (Hartshorn, 1983). The TWF is the most species-rich life zone in Costa Rica (Hartshorn, 1983).

On 19 October 2022 at 19:03 h we found an adult Yellow–headed Gecko being consumed by a Bromeliad Spider (Fig. 2). The spider was sitting on a post at approximately 1.10 m high along a roofed trail within the secondary forest of the botanical garden at the Selva Verde lodge. The gecko seemed dead and had a portion on the dorsum already eaten by the spider. We observed the event for about 10 minutes and took several pictures, during which neither our presence or the camera light and sounds disturbed the spider, which continued feeding on the gecko. We assume that the spider captured the gecko at its nocturnal refuge as *G. albogularis* is diurnal. However, we have observed some nocturnal activity by this gecko. Alternatively, the prey could have been taken from a spider web.

The information on predator–prey interactions between spiders and lizards is scattered, although some attempts have been made to systematize this information (Bauer, 1990;

Tabla 1. Vertebrados presa reportados específicamente para *Cupiennius coccineus*.

Table 1. Vertebrate prey items reported specifically for *Cupiennius coccineus*.

Species	Locality (Costa Rica)	Source
ANURA		
Craugastoridae		
**Craugastor* spp.	La Selva, Sarapiquí, Heredia.	Szelistowski, 1985.
***Craugastor bransfordii* Cope, 1886	La Selva, Sarapiquí, Heredia.	Murray et al., 2016.
Craugastor stejnegerianus (Cope, 1893)	La Merced, Uvita, Osa, Puntarenas.	Ervin et al., 2007.
Craugastor stejnegerianus (Cope, 1893)	Oro Verde, Osa, Puntarenas.	Ervin et al., 2007.
Pristimantis ridens (Cope, 1866)	Santa Elena, Monteverde, Puntarenas.	Jablonski, 2015.
Pristimantis ridens (Cope, 1866)	Tirimbina, Sarapiquí, Heredia.	Folt & Lapinski, 2017.
Hylidae		
****Agalychnis callidryas* (Cope, 1862)	La Selva, Sarapiquí, Heredia.	Stynoski et al., 2014.
Dendropsophus ebraccatus (Cope, 1874)	La Selva, Sarapiquí, Heredia.	Szelistowski, 1985.
Dendropsophus microcephalus (Cope, 1886)	Drake Bay, Osa, Puntarenas.	Cubas-Rodríguez & Teruel, 2022.
Duellmanohyla rufioculis (Taylor, 1952)	Rara Avis, Sarapiquí, Heredia.	Folt & Lapinski, 2017.
Smilisca sordida Peters, 1863,	Sierra Zapote, Abangares, Guanacaste.	Vega Cambronero et al., 2022.
Scinax elaeochroa (Cope, 1875)	La Selva, Sarapiquí, Heredia.	Szelistowski, 1985.
SQUAMATA		
Dactyloidae		
Anolis polylepis Peters, 1874	Sierpe, Osa, Puntarenas.	Núñez Escalante et al., 2021.
Sphaerodactylidae		
Gonatodes albogularis (Duméril & Bibron, 1836)	Selva Verde, Sarapiquí, Heredia.	**This report**

* Eleven individuals of an unknown number of species were eaten by several individuals of *Cupiennius coccineus* when the frogs were offered to them in a field experiment.

** This species was eaten by *Cupiennius coccineus* when the frogs were offered to it in a field experiment.

*** This species was eaten by *Cupiennius coccineus* when tadpoles of the species were offered to the spider in an experiment.

Reyes-Olivares et al., 2020; Nyffeler & Gibbons, 2022). In the Neotropical and Andean regions, the most commonly consumed species based on 50 reports are members of the Dactyloidae, Gymnophthalmidae, and Sphaerodactylidae (Reyes-Olivares et al., 2020). Geckos are easy targets for spiders due to their relatively small size and lack of strong teeth or claws for defense (Bauer, 1990; Valdez, 2020). Probably only the largest geckos are immune from arthropod attacks (Bauer, 1990). Other reports of spiders preying on Sphaerodactylid geckos includes a case of an adult female Yellow-headed Gecko that was captured in the web of a Golden Silk Orbweaver Spider (*Trichonephila clavipes*) in Northeastern Costa Rica (Filipiak & Lewis, 2012). Another *G. albogularis* was predated by a Wandering Spider *Phoneutria boliviensis* (Ctenidae) in Colombia (Valenzuela-Rojas et al., 2020). An additional predation event on *G. albogularis* by a Whip Scorpion (*Phrynus* sp.) was reported also from Colombia (Moreno-Arias, 2016). As we did not witness the initial encounter between the Bromeliad Spider and the Yellow-headed Gecko at Selva Verde, we were unable to verify if the spider captured the gecko directly. However, another nocturnal predator, the Common House Gecko (*Hemidactylus frenatus*), has also been reported as a predator of the diurnal Yellow-headed Gecko in Costa Rica, although this observation was from around 08:00 h inside a building (Barquero, 2017).

The activity patterns and hunting strategies of spiders and their lizard prey have not shown any significant association, suggesting that at least these two factors are not modulating

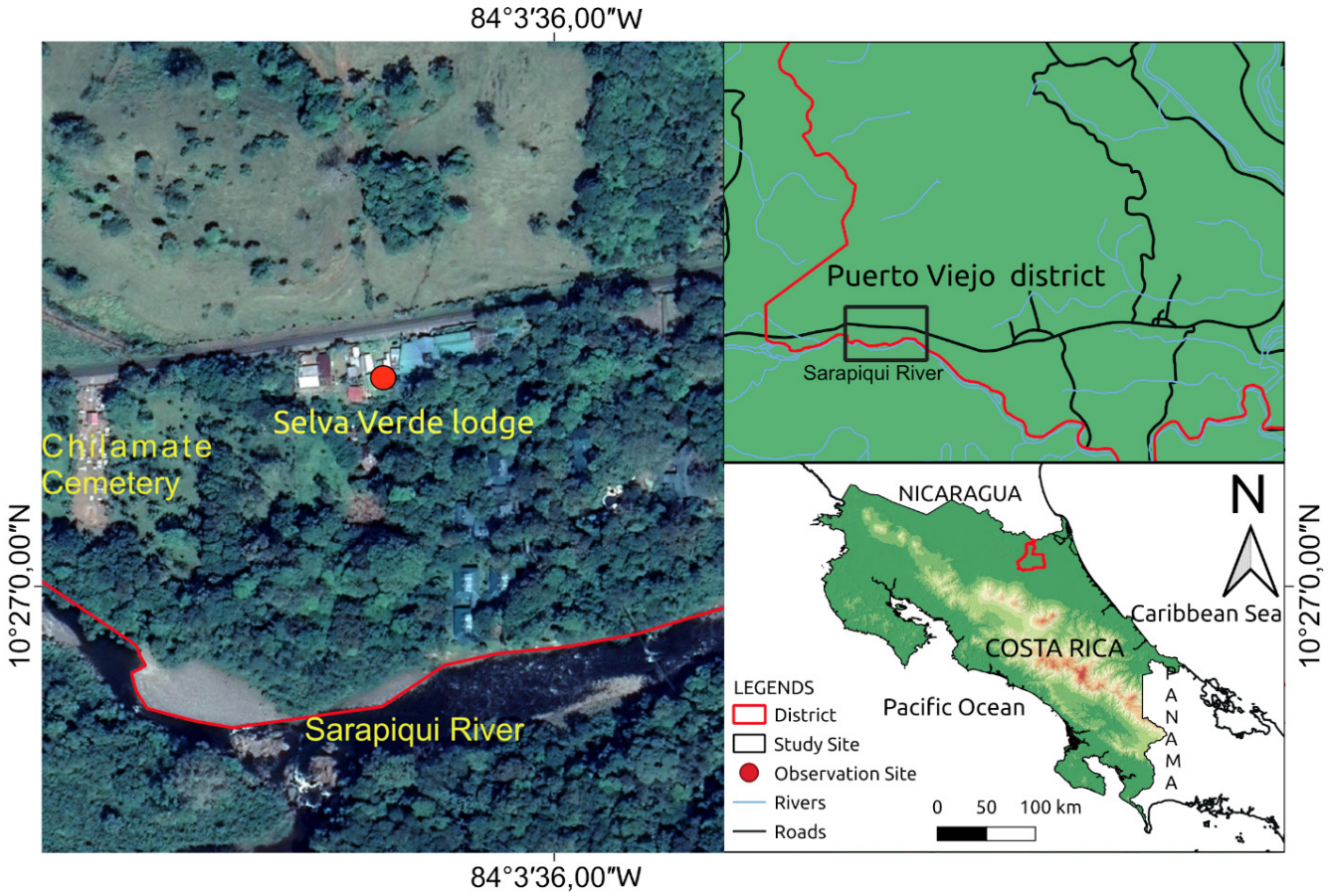

Figura 1. Sitio (punto rojo) donde un macho adulto del geco de cabeza amarilla (*Gonatodes albogularis*) fue depredado por una araña de bromelia *Cupiennius coccineus* en Selva Verde Lodge, Sarapiquí, Heredia, Costa Rica. Mapa: G. Chaves.

Figure 1. Site (red dot) where an adult male Yellow-headed Gecko (*Gonatodes albogularis*) was predated by a Bromeliad Spider *Cupiennius coccineus* at Selva Verde Lodge, Sarapiquí, Heredia, Costa Rica. Map: G. Chaves.

the predator–prey interactions among these two groups (Reyes-Olivares et al., 2020). However, there has been a trend reported of nocturnal spiders consuming diurnal lizards, and that ambush lizards were consumed by ambush predators (Reyes-Olivares et al., 2020).

Predation on vertebrates by arthropods is generally overlooked in ecological studies, as it is not typically observed in nature and generally considered rare events (Valdez, 2020). To observe predatory events in nature is difficult (Dias-Silva et al., 2021), and many predatory events involving spiders occur at night in remote tropical forests and swamplands (Nyffeler & Pusey, 2014). However, observations of these events is extremely important to help understand trophic networks (Passos et al., 2017; Dias-Silva et al., 2021). Furthermore, the consumption of vertebrates by spiders is more prevalent and widespread than previously believed, both in terms of geographic distribution and taxonomic diversity (Nyffeler & Gibbons, 2022). While many observations of arthropod attacks on geckos are based on serendipitous sightings of isolated incidents, certain arthropods rely significantly on vertebrates as a source of energy, thereby contributing to a notable proportion of small vertebrate mortality (McCormick & Polis 1982; Bauer, 1990). Recognizing and quantifying these predator-prey interactions is crucial to identify patterns and potential impacts of these relationships on shaping vertebrate populations and communities (Valdez, 2020). Information such as the event presented in this note, including the taxa involved in these interactions, is a critical first step to understand how strong the selective pressure of lizard consumption by spiders is, and so, how spiders can modulate

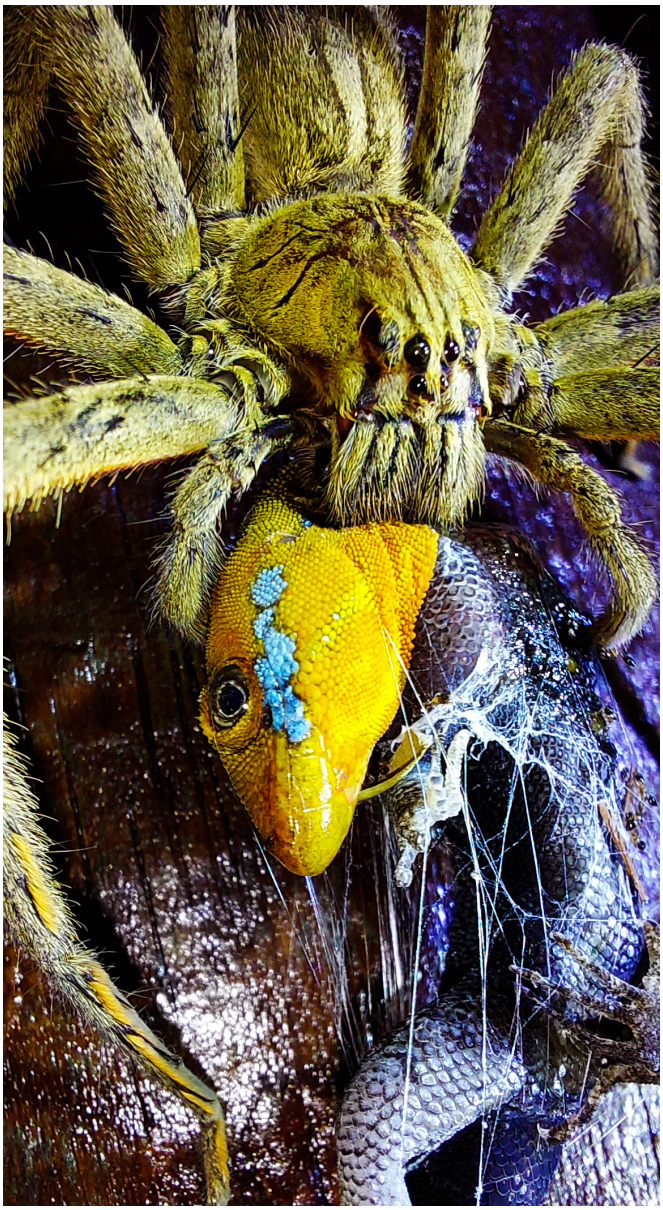

Figura 2. Un macho adulto del geco de cabeza amarilla (*Gonatodes albogularis*) siendo consumido por una araña de bromelia *Cupiennius coccineus* en Selva Verde Lodge, Sarapiquí, Heredia, Costa Rica. Foto: Randy Alvarado.

Figure 2. An adult male Yellow-headed gecko (*Gonatodes albogularis*) being consumed by a Bromeliad Spider *Cupiennius coccineus* at Selva Verde Lodge, Sarapiquí, Heredia, Costa Rica. Photo: Randy Alvarado.

lizard populations and their communities (Reyes-Olivares et al., 2020).

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