

Predation of spiders (Araneae) on amphibians and reptiles (Anura, Squamata) in Panama

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Abstract: The records of spider predation on amphibians or reptiles in Panama are scarce. We present seven cases of this intra-guild predator-prey interaction, with photographic records, thus improving the knowledge in this field for our country with six first reports and one previously documented report.

Key words Araneae, Anura, Squamata, behaviour, predator, prey, diet, ecology, Panama.

Predación de arañas (Araneae) sobre anfibios y reptiles (Anura, Squamata) en Panamá

Resumen: Los registros de depredación de arañas sobre herpetofauna en Panamá son escasos. Aquí presentamos siete casos de esta interacción intragremial depredador-presa, con registros fotográficos, ampliando de esta manera el conocimiento en este ámbito para nuestro país mediante seis primeros reportes y un reporte previamente documentado.

Palabras clave: Araneae, Anura, Squamata, comportamiento, depredador, presa, dieta, ecología, Panamá.

Introduction

Interactions between species are the basis of ecology, evolution, and natural history, so their rigorous documentation is vital to understanding the functioning of ecosystems (Bissattini *et al.*, 2020; Zipkin *et al.*, 2020; Eversole, 2022), the predator-prey relationship, for its part, represents a critical link for the flow of nutrients and energy and promotes the good functioning and stability of the ecosystem. Sometimes it occurs as intraguild predation, where two dominant species share the same prey. usually another less dominant species, generally in vertebrates, in this case amphibians and reptiles, by consuming invertebrates (Rosenheim *et al.* 1995, Reyes-Olivares *et al.*, 2020; Taucare-Ríos and Luri, 2021), however, there are records where vertebrates become prey for some invertebrates (McCormick and Polis, 1982; Armas, 2001; Oliveira and Pereira, 2014; Reyes-Olivares *et al.*, 2020; Cubas-Rodríguez *et al.*, 2023).

The Ctenidae and Trechaleidae families are the most common in terms of predation on amphibians and reptiles, with more than 90 and 30 records respectively (Menin *et al.*, 2005; Fonseca & Rodríguez-Cabrera, 2014; Folt & Lapinski, 2017; Von May *et al.*, 2019; Nyffler & Altig, 2020; Cubas-Rodríguez and Teruel, 2022), however, other families such as Theraphosidae have been reported preying on this group of vertebrates, especially snakes (Aguilar-López, *et al.* 2014 ; Lopez & Sherwood, 2019; Jiménez, 2021). These families have primarily nocturnal hunting spiders that move over leaf litter and use vibration and visual contact to locate their prey, trapping and killing them with their powerful venom, and are large enough to feed on frogs, lizards, and snakes (Jocqué and Dippenaar-Schoeman, 2006; Folt & Lapinski, 2017).

For their part, amphibians and reptiles represent a large part of the world's vertebrate biomass, which in turn participate in the food chain of many vertebrates such as reptiles, birds, mammals, and even other amphibians (Blaustein and Wake, 1990; Fuentes and Barria, 2023) and are sometimes prey to some species of spiders (Menin *et al.*, 2005).

This work seeks to expand knowledge about the intraguild predation relationship (spiders-amphibians/reptiles) in Panama.

Materials and Methods

The observation was made between the years 2011 and 2023 in seven different sites within the Republic of Panama, two of them in the Panama Canal basin, two in areas surrounding Portobelo National Park and one on an island in the Bocas del Toro archipelago, one in Calovebora in the Veraguas province and the last in the Chiriquí province, all areas have a humid tropical rain forest (Fig. 1, Table I). **Report 1.** report was documented using a digital camera Panasonic Lumix DMC-LS75, **Report 3 and 4.** semi-professional Canon Powershot SX 70HS, **Report 5 and 6.** semi-professional Canon Powershot SX 540HS digital camera and **Report 2 and 7.** Smartphone Samsung S8plus. This is the only record for which the specimens were collected, incorporating into the collections of the G. B. Fairchild Invertebrate Museum of the University of Panama the individual of the Ctenidae family with the collection number MIUP-LAV-FTCN-00001-2023 and the *Norops lionotus* to the Chiriquí Herpetological Museum with collection number MHCH3183, under the permit for the collection and use of genetic material ARB/ARG-047-2023 approved by the Ministry of the Environment of Panama, in the other reports no individual was collected.

Results

It is common that during scientific expeditions or scientific tourism interesting observations are generated, this is the case of five of the seven reports that we present in this work where individuals of the Ctenidae, Theraphosidae and Trechaleidae families were found just at the time when they were preying on representatives of the Classes Amphibia and Reptilia, specifically anurans, saurians and snakes.

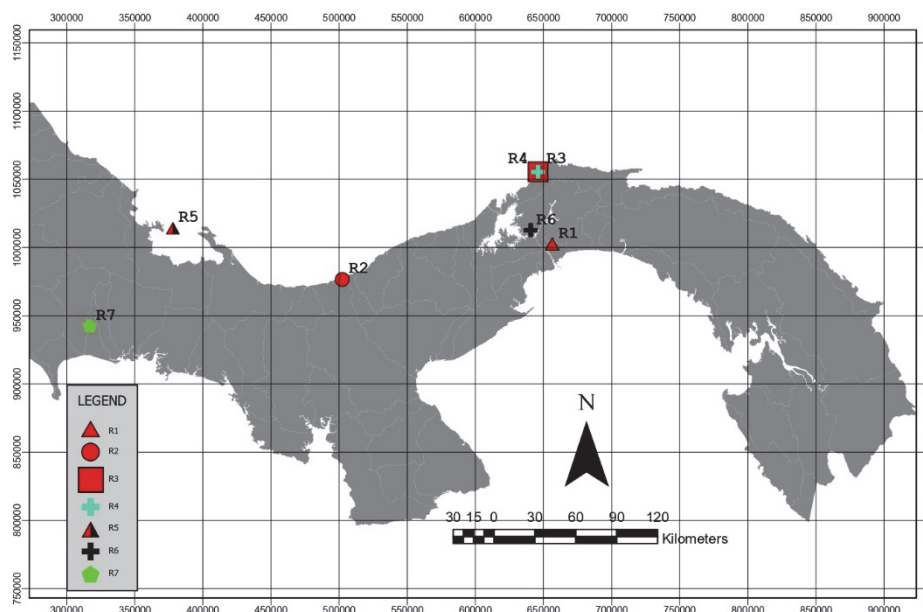


Figure 1. Maps of the predation events observation sites, Report (R)

Table I. Cases of field intraguild predation (Fig. 1)

Report	Location	Description
1.	During the second field trip of the study "Diversity and abundance of amphibians in the London 50 Ha environmental compensation project, Panama" (Fuentes <i>et al.</i> , 2023) on January 7, 2011, at 22:46 h, at the geographic coordinates 9°4'22.80"N, 79°34'37.20"W, 120 masl.	An individual of <i>Ancylometes bogotensis</i> (Keyserling, 1877) (Family Ctenidae) was observed on the rocks on the shore of stream 1A preying on a frog from the Eleutherodactylidae family (<i>Diasporus aff. quidditus</i>) that despite its good camouflage, it fell prey to this spider.
2.	During a scientific expedition, on April 10, 2019, at 21:27 h, Concepcion River, Calovebora, Veraguas province at the geographical coordinates 8°50'5.02"N, 80°58'45.38"W, 43 masl.	We observed the predation of an individual from the Family Theraphosidae on a snake from the Family Didapsidae (<i>Atractus sp.</i>).
3.	This observation occurred in the patio of the naturalist JA's residence, on December 23, 2019, at 22:28 h, in the vicinity of the Portobelo National Park at the geographical coordinates 9°32'44.08"N, 79°40'13.75 "W, 50 masl.	We observed the predation of an individual of <i>Phoneutria depilata</i> (Strand, 1909) (Family Ctenidae) on a juvenile of <i>Agallychnis callidryas</i> (Family Phyllomedusidae).
4.	During a field trip, on July 27, 2021, at 5:36 h, in the vicinity of the Portobelo National Park at the geographical coordinates 9°32'40.93"N, 79°40'11.58"W, 65 masl.	We observed the predation of an individual of <i>Cupiennius getazi</i> (Simon, 1891) (Family Trechaleidae) on a <i>Smilisca phaeota</i> (Family Hylidae), on the vegetation on the edge of a stream.
5.	During a scientific tourism tour called Go Herping tour on Popa Island, on August 19, 2021, at 20:32 h, on one of the Konsenda Bocas del Toro trails at the geographical coordinates 9°10'43.37"N, 82 ° 6'39.97"W, 20 masl.	We observed the predation of an individual of the Family Ctenidae on a frog of the Family Craugastoridae (<i>Craugastor aff. polyp-tychus</i>), in an open area of leaf litter going down towards a body of water.
6.	During a scientific tourism tour called Go Herping tour in the Soberanía National Park, on April 20, 2023, at 22:32 h, on the Pipeline trail at the geographical coordinates 9° 9'32.97"N, 79°43' 13.16"W, 77 masl.	We observed the predation of an individual of <i>Ancylometes bogotensis</i> (Keyserling, 1877) (Family Ctenidae) on a lizard from the Family Dactyloidae (<i>N. lionotus</i>), on a beach on the banks of a stream.
7.	During a scientific expedition in the Escarrea river, on October 18, 2023, at 13:46 h, on the Chiriqui province at the geographical coordinates 8° 31'37.6"N, 82°39' 47.6"W, 234 masl.	We observed the predation of an individual of Family Ctenidae on a frog from the Family Craugastoridae (<i>Craugastor fitzingeri</i>), in an open area of leaf litter.

Discussion

Little information is available on the importance of amphibians in the diet of arthropods; records are scarce and are related to opportunistic predation. (Maffei *et al.*, 2014). As in other reports, in the cases presented, the spiders were observed preying on the prey and the moment of capture was not observed and the prey did not show signs of decomposition, so we consider that they were captured minutes before the observation. Unlike what was proposed by Wise (1993) and Menin *et al.* (2005) who propose that some spiders feed on dead individuals that they find during their search for live prey, generally opportunistically and are not strict scavengers.

These three families of spiders are characterized by having species with a relatively large body and strong venoms, mainly neurotoxic (Medina, 2006; Foerster *et al.*, 2017; Nyffeler and Altig, 2020; Valenzuela-Rojas *et al.*, 2020; Hazzi and Ant, 2021; Cubas-Rodríguez *et al.*, 2023). They are also considered generalist predators that occupy terrestrial, arboreal and aquatic environments in tropical forests (Folt and Lapinski, 2017), this allows them to have a

wide range of prey and reduces competition for food, and this is confirmed by our reports, for example, the frogs *A. callidryas* and *S. phaeota* have arboreal habits and the observations were on the vegetation, *C. aff. polyptychus*, *C. fitzingeri* and the snake *Atractus sp.* are species associated with leaf litter, therefore, they are far from bodies of water, coinciding with the observation of the events, the species *N. lionotus* is associated with bodies of water, the observation was made right in the bank of a stream and, finally, the species *D. aff. quidditus* is a species with varied habits, even associated with rock walls near ravines, in all cases the spiders demonstrated to be active predators searching for each prey in each of the different types of habitats or strata, coinciding with predation patterns previously reported in other regions of the neotropics (Menin *et al.*, 2005; Folt & Lapinski, 2017; Cubas-Rodríguez and Teruel, 2022; Cubas-Rodríguez *et al.*, 2023).

It is the first time that these reports of predator-prey interaction (spider-frog) and (Spider-snake) have been published in the Republic of Panama, being the first record between species in all cases.

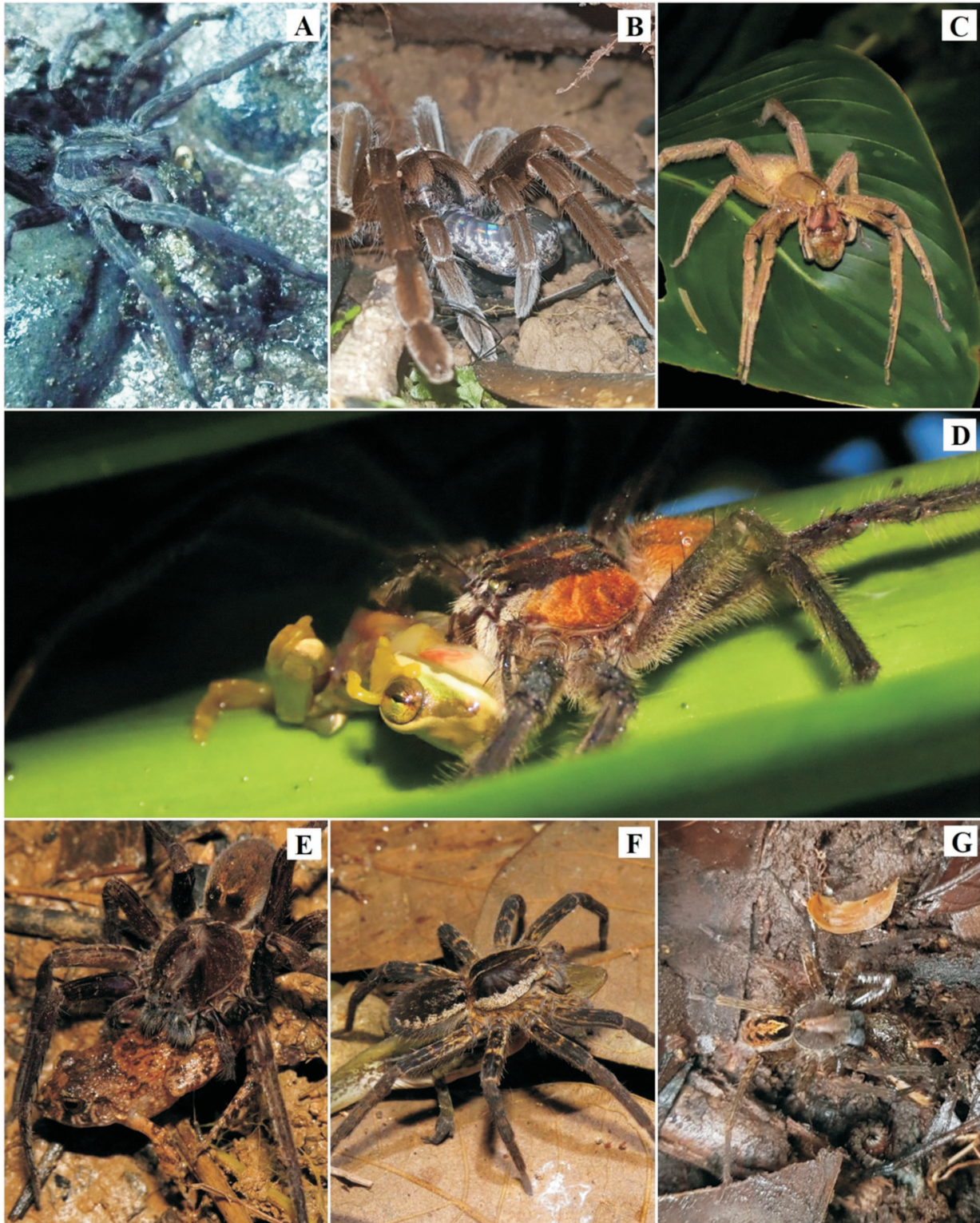


Figure 2. *Ancylometes bogotensis* preying on a *D. aff. quidditus* (A), Theraphosidae preying an *Atractus* sp. (B), Predation of *Phonetreria depilata* on a juvenile *Agalychnis callidryas* (C), Predation of *Cupiennius getazi* on a *Smilisca phaeota* (D), Ctenidae preying on a *Craugastor* aff. *polyptychus* (E), *Ancylometes bogotensis* preying on a *Norops lionotus* (F), Ctenidae preying on a *Craugastor fitzingeri* (G)

The predator-prey interaction (Spider-lizard) was reported for the first time in Panama by Bock and Quintero (1987) who reported a *Cupiennius* sp. preying on an *Anolis* (*Norops*) *limifrons*, since then and until now this interaction has not been reported again, this report being the first that involves a spider of the Ctenidae family and an *N. lionotus* and the second report of a Spider-lizard depredation in the country. In other studies, Ctenidae spiders were the most predatory species, mainly lizards from the families Dactyloidae and Gymnophthalmidae, which may be due to their high diversity, abundance, and

wide distribution in the Neotropical region (Torres-Carvajal *et al.*, 2016; Poe *et al.*, 2017; Midtgaard, 2020; Reyes-Olivares *et al.*, 2020).

These events seem to be more frequent than we thought, however, due to their occasional nature, they are difficult to document, coinciding with what was suggested by Pombal Jr. (2007), to expand this type of records in the wild we must increase our presence in the field, for example, the difference in reports in countries with biodiversity as similar as Costa Rica and Panama is undoubtedly due to

the sampling effort that increases the probabilities of these meetings in a directly proportional manner. The records presented provide valuable information on the natural history of these groups and increase our knowledge about the intraguild predation relationship between spiders and herpetofauna in Panama, highlighting the existence of important trophic connections between these groups.

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