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PREDATION OF A DRAB STREAMSIDE TREE FROG *SMILISCA SORDIDA* (ANURA: HYLIDAE) BY THE BROMELIAD SPIDER (*CUPIENNIUS COCCINEUS*) IN NORTHWESTERN COSTA RICA

DEPREDACIÓN DE UNA RANA ARBORÍCOLA PARDA *SMILISCA SORDIDA* (ANURA: HYLIDAE) POR LA ARAÑA ERRANTE (*CUPIENNIUS COCCINEUS*) EN EL NOROESTE DE COSTA RICA

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Resumen.– Las arañas de Trechaleidae pueden estar entre los depredadores más frecuentes de anuros pequeños en los bosques neotropicales. En esta familia, se sabe que *Cupiennius coccineus*, una de las especies más grandes del género, es depredadora de ranas. Tres de 15 eventos de depredación de ranas por arañas en Costa Rica fueron causados por esta especie que habita en la vegetación. Una rana hílida común en Costa Rica es la rana arborícola *Smilisca sordida* que normalmente se alimenta en la vegetación baja en áreas boscosas cerca de quebradas. Aquí presentamos el primer reporte de depredación sobre *S.sordida* por parte de *C. coccineus* basado en una observación hecha en el bosque húmedo de tierras bajas en el noroeste de Costa Rica.

Palabras claves.– anfibios, artrópodos, ctenidos, Neotrópico, Trechaleidae, vegetación ribereña.

Abstract.– Trechaleidae spiders may be one of the most frequent predators of small anurans in neotropical forests. In this family, the Bromeliad spider *Cupiennius coccineus*, one of the larger species of the genus, is known to predate on frogs. Three out of 15 spider predation events on frogs in Costa Rica were caused by this vegetation dweller species. A common hylid frog in Costa Rica is the Drab Streamside tree frog (*Smilisca sordida*) that normally forages on low vegetation in forested areas near streams. Here we present the first predation report of *S. sordida* by the Bromeliad spider *C. coccineus* based on an observation from the humid lowland forest of northwestern Costa Rica.

Key words.– amphibians, arthropods, Ctenids, Neotropics, streamside vegetation, Trechaleidae,

Drab Streamside tree frog *Smilisca sordida* (Peters, 1863) is a moderated-sized frog with males to 54 mm, and females to 64 mm in standard length, dull gray, tan, or reddish-brown, usually with irregular dark markings on its smooth dorsum (Duellman, 1970; Leenders, 2016). Flanks and posterior thigh surface are cream or with pale blue flecks (Savage, 2002), and the snout is long, rounded or sloping in profile (Leenders, 2016). Although somehow difficult to identify, its preference for riparian habitats may help to narrow down the options (Leenders, 2016).

Smilisca sordida is found in humid forests in the lowlands and on premontane slopes from northeastern Honduras to northwestern Panama on the Atlantic slope and in southwestern Costa Rica and adjacent western and west-central Panama

Figura 1. Una araña *Cupiennius coccineus* con una rana *Smilisca sordida* capturada en Reserva Sierra Zapote, Abangares, Guanacaste, Costa Rica.
Figure 1. A Bromeliad spider *Cupiennius coccineus* with a captured Drab Streamside tree frog *Smilisca sordida* in the Sierra Zapote Reserve, Abangares, Guanacaste, Costa Rica.

(Savage, 2002). It is a common frog in Costa Rica extended along the Pacific and Atlantic slopes (Leenders, 2016). It inhabits Lowland Moist and Wet Forest zones, some gallery forests in the Lowland Dry Forest zone, and Premontane Moist and Wet Forests (Savage, 2002), from 0 to 1800 m elevation (Sasa et al., 2010). Individuals hide during the day, but at night they are active in or near shallow, low-gradient rocky streams or on low vegetation, where it forages in forested areas near streams (Savage, 2002; Leenders, 2016). However, it can be found also in plantations, gardens, and urban areas, as long as a fairly intact corridor of streamside vegetation persists (Leenders, 2016).

Most amphibians feed principally on insects, although many species eat a wide variety of invertebrates (Pough et al., 2001). Large anurans commonly feed on large prey such as small mammals, birds, turtles, snakes, and other anurans (Duellman & Trueb, 1986). On the other side, because amphibians are numerous, small to moderate in size, and have soft skin, they are common prey for a great variety of predators including vertebrates and invertebrates, mainly arthropods (Duellman & Trueb, 1986). Among vertebrates, fish, turtles, crocodilians, snakes, birds, mammals, and some carnivorous frogs are amphibian predators (Pough et al., 2001). Besides, several invertebrates predate amphibians, including a high number of spiders (Pough et al., 2001; Nyffeler & Altig, 2020). Amphibians may be caught in webs and then killed and eaten, however, several types of hunting spiders spring on amphibian prey, grasp them, and kill by injection (Duellman & Trueb, 1986). Wandering spiders of Trechaleidae may be one of the most frequent predators on small anurans and lizards in neotropical forests (Folt & Lapinski, 2017; Prémel & Torres, 2021).

Species of the genus *Cupiennius*, sometimes known as banana spiders, are associated to plants such as bananas, heliconias and bromeliads where they construct silken retreats sallying forth after dark to hunt (Hanson & Nishida, 2016). This neotropical

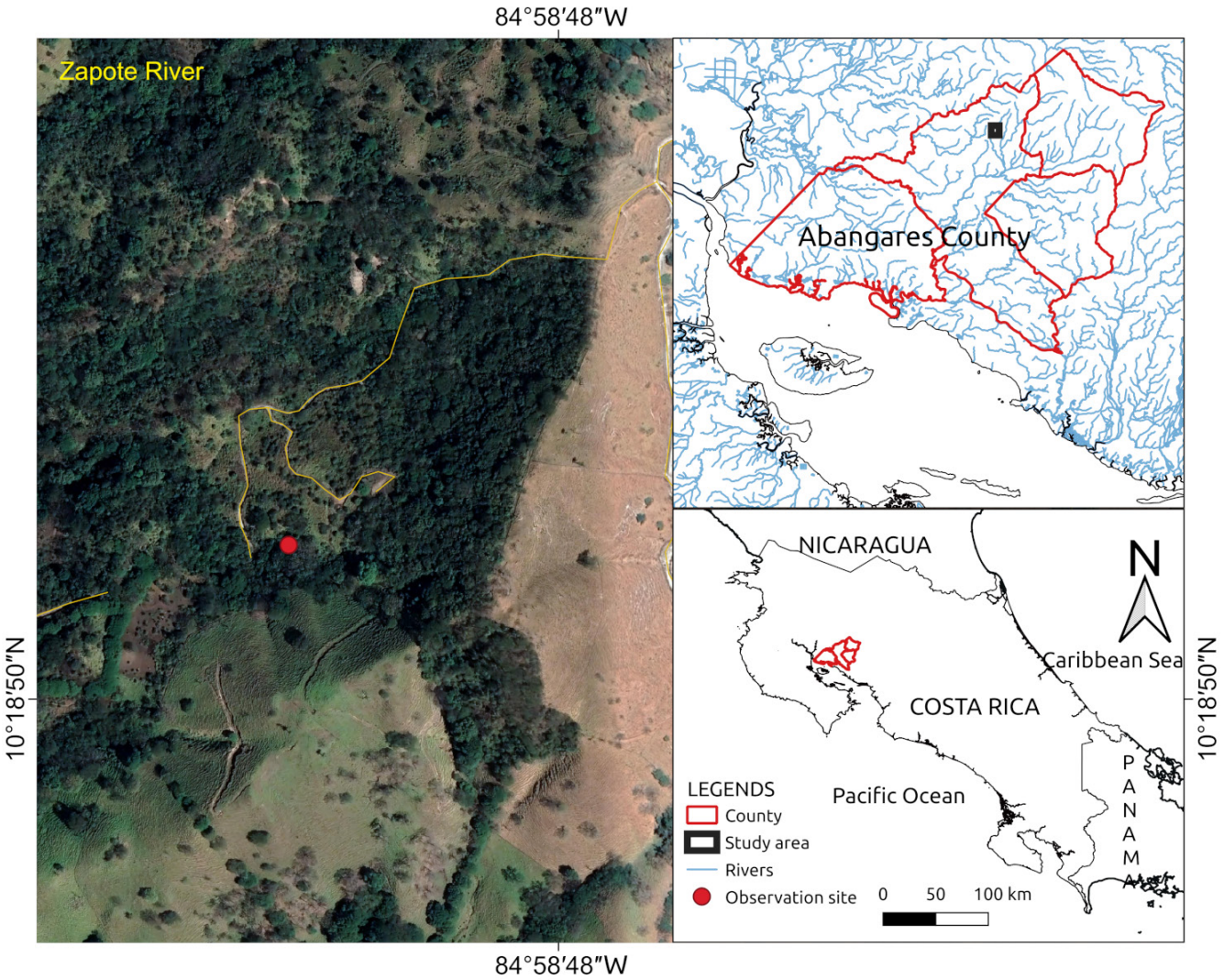

Figura 2. Localidad y hábitat general donde se encontró una *Cupiennius coccineus* depredando una *Smilisca sordida* en Abangares, Guanacaste, Costa Rica.

Figure 2. Locality and general habitat where a *Cupiennius coccineus* was found predating a *Smilisca sordida* at Abangares, Guanacaste, Costa Rica

genus has 11 species distributed from Mexico to northern South America, and La Española in the Caribbean (World Spider Catalog, 2022). The Bromeliad spider *C. 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 basic color, but the underside of the femora of the front pair of legs of the female has a conspicuous red warning color, which is shown as a threatening gesture to a potential predator in case of danger (Barth & Cordes, 1998; Vetter & Hillebrecht, 2008).

Cupiennius coccineus inhabits rainforests over an extended area from Guatemala to Colombia, and also records from Cuba and Haiti (Vetter & Hillebrecht, 2008). Some specimens have been found in Europe and the United States, however, these records are the product of fruit exports such as bananas, in whose boxes individuals have traveled (Barth et al., 1988). In Costa Rica this species has been found from lowlands sites such as La Selva Biological Station at 37 m elevation, to highlands such as San José at 1135 m elevation (Barth et al., 1988). They are easily found at night on the leaves of heliconias and banana plants, and during the day they remain hidden in rolled leaves or among the sheaths of large leaves (Barth et al., 1988). It frequents the lower parts of the forest, rich in heliconias and broad-leaved plants where it finds its favorite habitat, since these plants serve as a platform to hunt (Barth et al., 1988). *Cupiennius coccineus* does not construct webs but ambush and capture prey directly from

the surface of leaves and other plant parts they use to send and receive vibrations (Barth et al., 1988). This species as well other in the genus are known predators of frogs (Prémel & Torres, 2021). However, here we present the first report of predation over *S. sordida* by the Bromeliad spider *C. coccineus* in the wild.

On 05 May 2020 at 21:24 h we found a Bromeliad spider walking on the trunk of a small tree with a captured Drab Streamside tree frog (Fig. 1). The spider was at 1.60 m high approximately, and the frog seemed alive but paralyzed. After a couple of minutes, the spider carried the frog to a site out of sight, and we did not want to search for it to avoid disturbing it because we did not a have a research permit. As a result, we were not able to record the time invested by the spider to consume the frog or any other behavior. We observed this event at an area in regeneration near Zapote river at the Sierra Zapote Reserve (SZR), Abangares, Guanacaste, Costa Rica (10°18'55.7" N, 84°58'57.3" W; 296 m elevation; Fig. 2). The SZR is located in the humid forest of northwestern Costa Rica (Fig. 2), an area with a prolonged dry season. The rainy season normally begins in May or June; it did not rain during the day of the observation.

Predation of amphibians by Wandering spiders (formerly Ctenidae) is very well documented in many cases and different species of the Neotropical region, and include frogs but also salamanders (Jablonski, 2015; de Oliveira Meneses et al., 2021; Nuñez et al., 2021). Eighteen species of "Ctenidae" were involved in 89 out of 374 predation events where Hylidae with 67 species was the most representative family with 111 incidents (Nyffeler & Altig, 2020). However, the spider-amphibian predation events include a huge variety of species of both taxa. Until 2020, 199 species of frogs belonging to 30 families were known to be killed and eaten by spiders in the wild, while 106 spider species had been reported to prey on frogs under natural conditions (Nyffeler & Altig, 2020).

Most of frog captures are executed by nocturnal spiders, and the majority of these predators were cursorial hunters (85% of the 374 incidents) known to capture prey without a web (Nyffeler & Altig, 2020). One example of the last type is the genus *Cupiennius* that has been reported to predate on five frog species from Centrolenidae, Craugastoridae, and Hylidae (Folt & Lapinski, 2017; Nyffeler & Altig, 2020; Cotoras & Goyes Vallejos, 2021). We found at least 15 predation events of amphibian predation by spiders in Costa Rica, five of them by species of *Cupiennius* (Folt & Lapinski, 2017; Cotoras & Goyes Vallejos, 2021; Nuñez et al., 2021). Three of this predation events were executed by *C. coccineus*. This is a vegetation dweller species and it was the most abundant species on trees at the Caribbean lowlands of Costa Rica (Lapinski & Tschapka, 2018). On the other hand, *S. sordida* is a tree frog that normally forages on low vegetation in forested areas near streams (Leenders, 2016). This is a perfect condition for *C. coccineus* to prey on the Drab Streamside tree frog.

The variety of predation events include even poisonous frogs (e.g., *Dendrobates auratus*), and the use of webs to capture the prey or ambush and hunt them (Summers, 1999; Ugarte & Briggs, 2007; Ferreira Da Silva et al., 2015; Ganong & Folt, 2015). Although an adult male *S. sordida* was caught by the spider *Ancylometes bogotensis* (Dehling, 2007), to the best of our knowledge this is the first report of *C. coccineus* predating on *S. sordida*.

To observe predatory events in nature is difficult (Dias-Silva et al., 2021), many of events involving spiders and frogs occur at night hours in remote tropical forests and swamplands (Nyffeler & Pusey, 2014). However, the observation of these events are extremely important to help understand trophic networks (Passos et al., 2017; Dias-Silva et al., 2021). The record of *S. sordida* being predated by *C. coccineus* increases our knowledge of the relationship between spiders and anurans, and helps to highlight the trophic connections between anurans and spiders. Under most circumstances frogs are probably only marginal food for spiders (Nyffeler & Altig, 2020). However, quantitative investigations on the natural predation on amphibians by tropical spiders are needed before reliable conclusions on the impact on amphibian populations can be drawn.

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