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PREDATION EVENT OF MILK FROG *TRACHYCEPHALUS TYPHONIUS* (ANURA: HYLIDAE) ON A COMMON HOUSE GECKO *HEMIDACTYLUS FRENATUS* (SQUAMATA: GEKKONIDAE)

EVENTO DE DEPREDACIÓN DE LA RANA LECHERA *TRACHYCEPHALUS TYPHONIUS* (ANURA: HYLIDAE) SOBRE EL GECO CASERO COMÚN *HEMIDACTYLUS FRENATUS* (SQUAMATA: GEKKONIDAE)

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Resumen.— Las observaciones de eventos de depredación son poco comunes. Estos eventos son importantes para ayudar a entender las redes tróficas de las comunidades biológicas en general y de las especies introducidas en particular. La rana lechera (*Trachycephalus typhonius*) se alimenta de insectos y otros artrópodos, pero se han reportado algunos pocos casos de vertebrados en su dieta: una rana *Hypopachus variolosus* en México, un murciélago *Myotis nigrescens* en el pantanal de Brasil y un adulto de la rana *Dendropsophus soaresi* también en Brasil. Aquí reportamos la depredación de la rana lechera sobre un geco casero común (*Hemidactylus frenatus*) en Bajamar, Puntarenas, Costa Rica. La observación se hizo en una casa de habitación en un área de pasturas con árboles cerca de un manglar.

Palabras clave.— Anfibios, especies introducidas, hábitats alterados, ranas arborícolas, reptiles.

Abstract.— Observations of predation events are rare. These events are important to help understand trophic networks of biological communities in general and of introduced species in particular. Milk frogs (*Trachycephalus typhonius*) feed on insects and other arthropods, but some cases of vertebrates have been reported in its diet: a Sheep toad (*Hypopachus variolosus*) in México, a Black Myotis (*Myotis nigrescens*) in the Pantanal of Brazil, and an adult tree frog of *Dendropsophus soaresi* also in Brazil. Here we report the predation of an adult Milk frog on a Common house gecko (*Hemidactylus frenatus*) in Bajamar, Puntarenas, Costa Rica. The observation was made in a house in an area of pastures with trees near a mangrove swamp.

Keywords.— Altered habitats, amphibians, introduced species, reptiles, tree frogs.

Predation influences several key aspects of fitness such as feeding, breeding, and often, ultimately, mortality, and as such it is fundamental to the lives of wild animals (Humphreys & Ruxton, 2018). Natural selection, ecological structuring of communities, and the functioning of ecosystem have on predator-prey interactions one of the main drivers (Valdez, 2020). Observation of predatory interactions is extremely important to help understand trophic networks (Passos et al.,

2017; Dias-Silva et al., 2021), however, to observe them in nature is difficult (Dias-Silva et al., 2021).

Prey types ingested by predators are determined by the influence of their searching behavior and habitat types (Van-Sluys & Rocha, 1998). Anurans can consume a wide variety of prey such as arthropods but also small vertebrates including other species of amphibians (Vitt & Caldwell, 2009). Most frogs and toads are generalist and opportunistic foragers, taking the preys available at the moment in their habitats (Vitt & Caldwell, 2009). Invasions of new sites by native or exotic species create new predation interrelationships, especially notable in opportunistic species inhabiting human settlings. These settlings generally offer unusual and abundant resources for some species. For example, artificial light at night is one of the multiple effects of human development (Maurer et al., 2019), and lights in streetlights and houses attract insects and they attract predators, including bats, lizards, and amphibians (Owens & Lewis, 2018; Maurer et al., 2019). Several species of geckos have been introduced in different parts of the world, such as Spiny-tailed House gecko (*Hemidactylus frenatus* Duméril and Bibron, 1836). This gecko is often found inside buildings feeding on insects (Neogi & Islam, 2017). However, some native species may behave similarly such as Milk frog *Trachycephalus typhonius* (Linnaeus, 1758), and at night individuals are often seen clinging to walls of buildings, where they prey on insects attracted to electric lights (Lee, 2000). This species is another generalist and opportunistic anuran predator which feeds primarily on small invertebrates, especially insects (Lee, 2000).

As currently defined, *Trachycephalus typhonius* is a widely distributed arboreal frog occurring from tropical Sinaloa, Mexico to eastern Panama on the Pacific slope and from Tamaulipas, Mexico to northern Nicaragua on the Caribbean slope (Savage, 2002). In South America Milk frog inhabits Colombia and Ecuador west of the Andes, and from eastern Venezuela and the Guianas to southern Brazil in the Amazon basin, extending to northern Argentina (Savage 2002, La Marca et al., 2010). It is also found in Trinidad and Tobago in the Caribbean (La Marca et al., 2010). In Costa Rica, the species inhabits mainly the Pacific

Figura 1. Rana lechera (*Trachycephalus typhonius*) consumiendo un geco casero común (*Hemidactylus frenatus*) en Bajamar, Puntarenas, Costa Rica.
Figure 1. Milk frog (*Trachycephalus typhonius*) consuming a Spiny House gecko (*Hemidactylus frenatus*) at Bajamar, Puntarenas, Costa Rica.

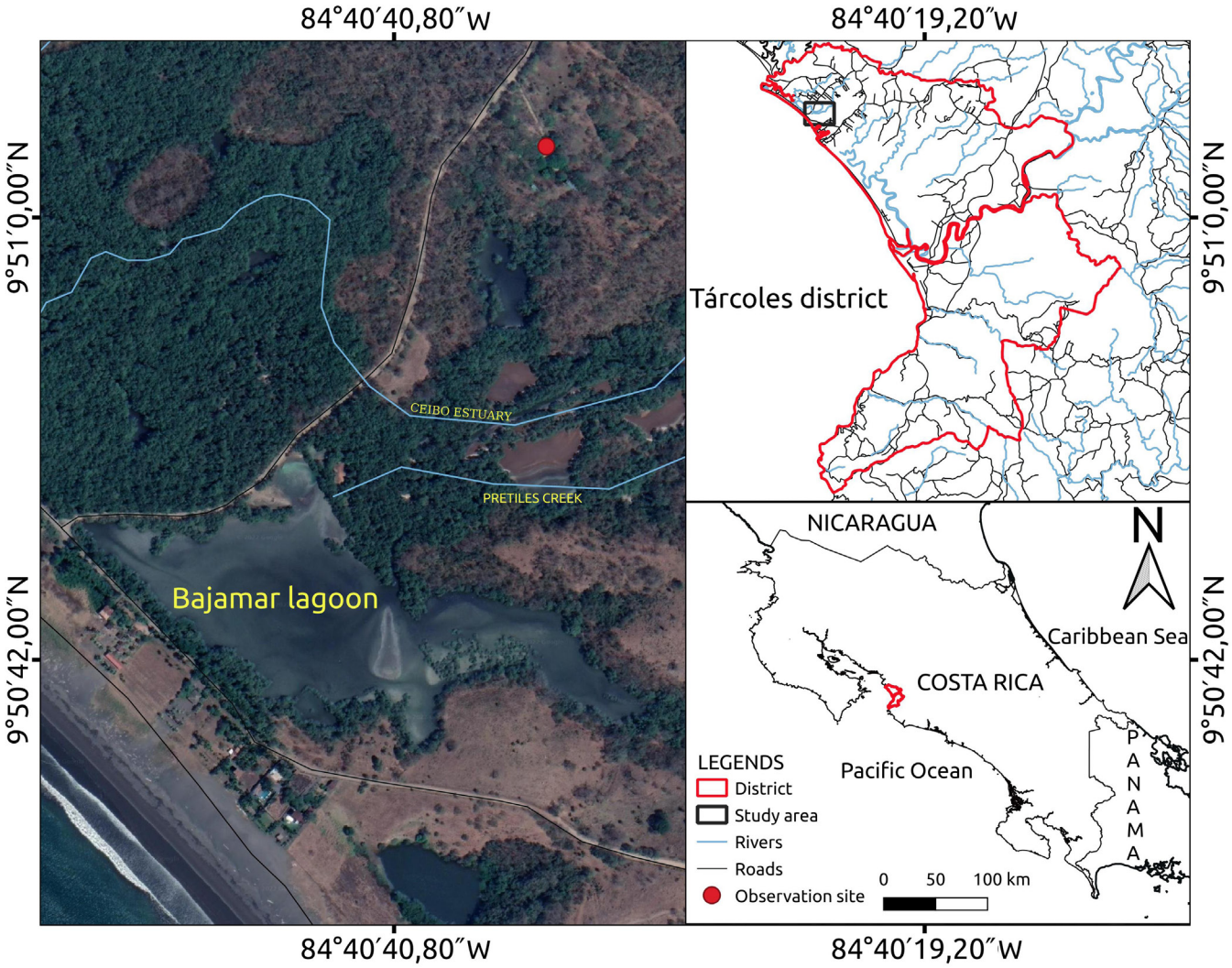

Figura 2. Localidad y hábitat general donde se encontró una *Trachycephalus typhonius* depredando un *Hemidactylus frenatus* en una casa (pin rojo) en Bajamar, Puntarenas, Costa Rica.
Figure 2. Locality and general habitat where a *Trachycephalus typhonius* was found predating a *Hemidactylus frenatus* at a house (red pin) at Bajamar, Puntarenas, Costa Rica.

lowlands (Leenders, 2016) between 2-1145 masl (Sasa et al., 2010; Mora et al., 2021). In general, the species occurs in diverse habitats including dry and moist habitats, forested or artificial open areas such as gardens and plantations as well as human housing (Savage, 2002; García Mata et al., 2020).

Trachycephalus typhonius is a large hylid frog with distinctively glandular skin (Leenders, 2016). Glands produce milky secretions with impressive adhesive properties not water soluble (Vitt & Caldwell, 2009). These harmful, irritating secretions contain various poisonous alkaloids that are potentially lethal to predators (Vitt & Caldwell, 2009). The venomous properties of the skin of *Trachycephalus typhonius* are well known and have been documented by several authors (Duellman, 1970). It has been also argued that gland secretions are produced as an adaptive response to arid environments (McDiarmid, 1968). The secretions are used to protect the frogs against dehydration lining cavities of trees where they seek refuge (McDiarmid, 1968).

Hemidactylus frenatus inhabited originally only southeastern Asia, but it has been introduced to several islands, Australia, América and Africa (López & Mora, 2021). It is a nocturnal and arboreal small gecko (snout–vent length up to 67 mm), grayish-brown or dusky brown dorsum, sometimes with darker markings, and venter unpatterned cream or light beige (Das, 2010). This gecko occurs naturally in forests, but most commonly it is associated with human housing (Parmar & Tank, 2019). *Hemidactylus frenatus* is preyed upon by several

animals, mainly snakes and larger lizards such as *Thecadactylus rapicauda* (Leenders, 2019), as well as some diurnal species such as birds (Rojas-González & Wakida-Kusunoki, 2012; Yannarella & Abarca, 2017) and primates (Mata-Silva et al., 2013). Here we report on the first record of predation on *Hemidactylus frenatus* by *Trachycephalus typhonius*.

On December 4th, 2020 at 2140 h an adult Milk frog was observed capturing and consuming a Spiny House gecko (Fig. 1). The frog was observed with the gecko in its mouth and consumed it in few minutes (actual time was not measured). The event was observed at Bajamar, Puntarenas, Costa Rica (9°51'02.9" N, 84°40'34.6" W; 17 m elevation). The frog consumed the gecko on the outside wall of a house at 1.90 m high approximately. The house is located on an area of pastureland with trees near a mangrove (Fig. 2).

In general, the largest hylids such as *Trachycephalus typhonius* consume orthopterans and roaches as their primary prey (Parmelee, 1999). Prey of Milk frog includes spiders, orthopterans, dipterans, homopterans and coleopterans, with this last group and hymenopterans the most consumed ones (Mineros Ramírez, 2016). Several studies have shown that this species is generalist and opportunistic (Vaz-Silva et al., 2004; Dure & Kehr, 2006; Mineros Ramirez, 2016). Trophic plasticity in generalist amphibians provides them an advantage in disturbed environments where prey availability changes (López et al., 2015; Mineros Ramírez, 2016). This ability allows *Trachycephalus typhonius* to inhabit disturbed environments such as agroecosystem and even human housing (La Marca, 2010; Mineros Ramírez, 2016).

A *Trachycephalus typhonius* was photographed feeding on a scorpion (*Centruroides* sp.) in a house in Santa Rosa National Park in Costa Rica. Although the frog was stung several times by the scorpion, it did not show any side effects (Mesoamerican Herpetology, 2014). Besides invertebrates, it has been reported that Milk frog has consumed small vertebrates in natural and disturbed environments.

There is a record of a Milk frog ingesting a Sheep toad (*Hypopachus variolosus*) in México (Dundee & Liner, 1985). It was also reported as feeding on a Black Myotis (*Myotis nigrescens*) in the Pantanal, Brazil (Strüssmann & Sazima, 1991). This bat as well as probably the frog shelter in tree cavities and crevices in the Pantanal, so enhancing the possibilities of predation events (Strüssmann & Sazima 1991). More recently, Loebmann (2013) described a *Trachycephalus typhonius* preying on an adult of *Dendropsophus soaresi* in Northeastern Brazil. Nevertheless, this was the only amphibian ingested by Milk frog from a sample of 70 examined (Loebmann 2013). Amphibian predation by Milk frog seems to be unusual, considering the few records known (Loebmann, 2013). The House gecko reported here ingested by a Milk frog adds a new vertebrate to this short list and it is the first report of a lizard predated by this species. Given the abundance of this gecko and the adaptability of Milk frog to human housing, this predatory relationship could be common.

Trachycephalus typhonius is a "sit and wait" predator (Parmelee, 1999) and it is often found on building walls (García Mata et al., 2020). The house gecko is commonly seen at night on the walls and ceilings of buildings hunting insects that have been attracted by electric lights (Leenders, 2019). As a result, encounters of these two species could be frequent. This event is relevant to broad our understanding of predator-prey interactions, mainly given the two species involved. The House gecko is an introduced species, and introduced species is one of the main causes of biodiversity deterioration (Dwivedi et al., 2017). On the other hand, Milk frog is a winner among the highly threatened amphibians (Mora et al., 2022). This encounter offers important information about their natural history, helpful to understand their biology for conservation purposes.

Recent studies have shown that Milk frog inhabiting Central America is not *T. typhonius*, instead it may be *T. quadrangulum* (Ron et al., 2016). Even if it is not this species, *T. quadrangulum* provides a name to an evolutionary lineage separate from *T. typhonius*, an arrangement that better reflects the evolutionary history of Chocoan and Central American populations (Ron et al., 2016). Anyhow, largest individuals of *T. typhonius* are found in northwestern Mexico and southern Costa Rica and Panamá (McDiarmid, 1968; Duellman, 1970). Body size influences the size of prey taken by predators and as such the kind of vertebrates ingested by Milk frog would vary depending on this, geography and distribution of species involved. Whatever the species of Milk frog is in Central America, it offers research possibilities, in particular due to its abundance. Future studies may include the determination of specific factors that allow Milk frog to survive in different habitat types. This may offer insights about habitat restoration for other species with diminishing populations. Also, it could be useful to study Milk frog trophic ecology in relation to resource limitation to it and to other sympatric anuran species. Changes in resource availability in altered habitats may be more important that structure to maintain species such as Milk frog.

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Nota de la Editora-en-Jefe: De acuerdo con la página Amphibian Species of the World (https://amphibiansoftheworld.amnh.org/Amphibia/Anura/Hylidae/Lophyohylinae/Trachycephalus/Trachycephalus-typhonius) la especie *Trachycepahlus typhonius*, no se distribuye en Costa Rica. Con los cambios nomenclaturales que realizaron Ron et al. (2016) dejaron a las poblaciones al oeste de los Andes hasta el sur y este de México sin nombre(s), aunque según Frost (2021) está muy claro que ninguna de estas poblaciones será conespecífica con *Trachycephalus typhonius*. Debido a lo anterior se ha usado *T. "vermiculatus"* provisionalmente. La asignación de las poblaciones en Centro América y México no se ha resuelto hasta la fecha.

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