

THE OCCURRENCE OF THE MILK FROG *TRACHYCEPHALUS TYPHONIUS* (AMPHIBIA: HYLIDAE) IN THE CENTRAL VALLEY OF COSTA RICA

PRESENCIA DE LA RANA LECHERA *TRACHYCEPHALUS TYPHONIUS* (AMPHIBIA: HYLIDAE) EN EL VALLE CENTRAL DE COSTA RICA

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Received: 2021-10-28. Accepted: 2021-12-07. Published: 2022-02-03.

Editor: Andrea Paz, Colombia.

Resumen.— *Trachycephalus typhonius* es una especie común en varios tipos de hábitat y tiene una amplia distribución desde México hasta el sur de Brasil y norte de Argentina. En Costa Rica habita las tierras bajas del Pacífico y marginalmente en la cuenca del río San Juan cerca de la frontera con Nicaragua. No obstante, sus registros en Costa Rica son limitados. Aquí reportamos la presencia de esta especie en el Valle Central de Costa Rica a 1145 m de elevación en el bosque tropical premontano húmedo. Este registro es el primero para esta zona de vida en Costa Rica lo que podría indicar que la especie se ha expandido a nuevos ambientes climáticos. No obstante, y aunque la especie no se había reportado en esta localidad, es posible que tenga una distribución histórica aquí, pero sus poblaciones han sido afectadas por cambios en el uso del suelo.

Palabras clave.— Bosque húmedo premontano tropical, conservación, especie ganadora, ranas arborícolas, zonas de vida.

Abstract.— *Trachycephalus typhonius* is a common species in several habitat types, and it has a wide distribution from Mexico to southern Brazil and northern Argentina. In Costa Rica, it inhabits the Pacific lowlands and marginally in the San Juan River basin near the border with Nicaragua. However, their records in Costa Rica are limited. Here we report the presence of this frog in the Central Valley of Costa Rica at 1145 m elevation in the Tropical Premontane Moist forest. This record is the first for this life zone in Costa Rica, which could indicate that the species has expanded to new climatic environments. However, and although the species had not been reported in this locality, it is possible that it has a historical distribution here, but its populations have been affected by changes in land use.

Keywords.— Conservation, tree frogs, life zones, tropical premontane moist forest, winner species.

Amphibia is a highly diversified group in Costa Rica where at least 215 species have been detected (Rodríguez et al., 2020). In this high number, the 38 native tree frogs of the Hylidae family stand out (Duellman et al., 2016; Rodríguez et al., 2020) with some rare species such as *Isthmohyla xanthosticta* which is only known from a single individual and some other very common such as *Trachycephalus typhonius* (Leenders, 2016). This species is a giant in this family that also includes tiny ones such as

Isthmohyla zeteki showing the extreme variability in shape and size of tree frogs in Costa Rica (Leenders, 2016).

The genus *Trachycephalus* includes 14 species of large, casque-headed tree frogs that have a helmetlike skull and green bones (Duellman et al., 2016). Milk frog *Trachycephalus typhonius* (Linnaeus, 1758) is the only species of the genus found in Central America (Ron et al., 2016). This frog has a perplex taxonomic



Figura 1. Una *Trachycephalus typhonius* encontrada en un área semiurbana en Palmares, Alajuela, en el Valle Central, Costa Rica. Foto: Miguel A. Rodríguez.

Figure 1. A *Trachycephalus typhonius* found in a semi-urban area in Palmares, Alajuela, in the Valle Central, Costa Rica. Photo: Miguel A. Rodríguez.

history since first described by Linnaeus (1758) as *Rana typhonia* (Lavilla et al., 2010). Until some years ago it was referred as *Phrynohyas venulosa* (e.g. Duellman, 1970) and then *Trachycephalus venulosus* (e.g. Faivovich et al., 2005), but Lavilla et al. (2010) defined its identity and gave the name combination accepted today. However, the species presents high morphological variation (e.g. McDiarmid, 1968), so it may represent a species complex (Savage, 2002; Lavilla et al., 2010), a fact supported by a high variety of advertisement calls (Zaracho et al., 2018).

Among many South American hylid taxa dispersed northward, Milk frog presents the greatest distribution reaching Mexico

and occupying all of tropical Middle America (Duellman et al., 2016). As currently defined, this species has a wide distribution ranging from Sinaloa, México to eastern Panama on the Pacific slope and from Tamaulipas, México to northern Nicaragua on the Caribbean slope (Leenders, 2016). In South America Milk frog inhabits Colombia and western Ecuador along the Pacific slope, eastern Venezuela, Trinidad and Tobago, the Guianas to southern Brazil in the Amazon basin, extending to northern Argentina (Savage, 2002; La Marca et al., 2010).

Milk frog is commonly observed in forest, forest edges, savanna, and secondary growth, but it is especially common

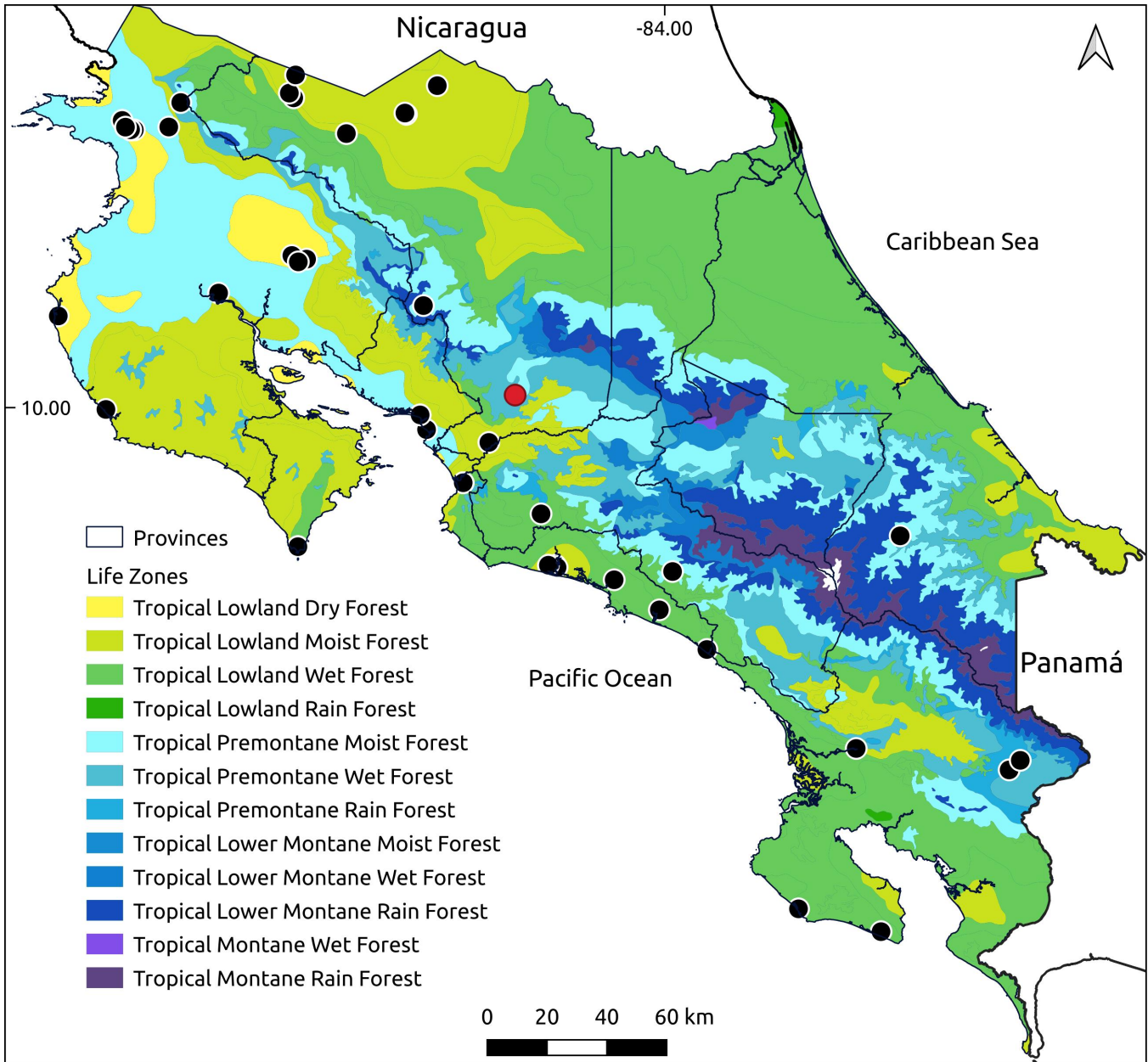


Figura 2. Distribución de *Trachycephalus typhonius* en Costa Rica basada en registros del Museo de Zoología, Universidad de Costa Rica (puntos negros), y los registros recientes de la cuenca alta del río Térraba, Coto Brus. El Nuevo registro del Valle Central está indicado con un punto rojo. Mapa: Gerardo Chaves.

Figure 2. Distribution of *Trachycephalus typhonius* in Costa Rica based on records stored at the Museo de Zoología, Universidad de Costa Rica (black dots), and the recent records from the upper basin of the Río Térraba, Coto Brus. The new record from the Valle Central is indicated with a red dot. Map: Gerardo Chaves.

in open habitat types and persists in disturbed habitats and plantations (Leenders, 2016). We have observed this species commonly in lowland protected areas such as Palo Verde and Santa Rosa national parks, even on walls and building sinks; it is regularly found in or near human dwellings (La Marca et al.,

2010). This frog is very striking among other things because it is one of the largest tree frogs in the country with about 114 mm of snout-vent length (Leenders, 2016). Despite being a common species, its records in Costa Rica are limited (Gómez-Hoyos et al., 2020).

In Costa Rica, Milk frog inhabits the Pacific lowlands and marginally in the San Juan River basin on the northern slope (Savage, 2002) on the border with Nicaragua (Leenders, 2016). It is known from lowlands up to 1100 m a.s.l. (Sasa et al., 2010). Here it inhabits dry, humid, and very humid forests where it is common to observe at breeding sites in temporary ponds and at night in the dry season perching on branches and vegetation while foraging (Savage, 2002). Milk frog uses parachuting as part of its locomotion abilities (Leenders, 2016). The species occurs mainly in areas with a prolonged dry season where during the day it hides in bromeliads, tree hollows, under the bark of live and dead trees or sheaths of heliconia and bananas (Savage, 2002).

Milk frog is large and robust with distinctively glandular skin (Leenders, 2016). Its color ranges from pale grayish to reddish brown with a dark dorsal blotch covering its back, although this may be uniform in color (Savage, 2002). Males of this species have paired lateral vocal sacs behind angles of the jaw (Lee, 2000; Moura et al., 2021). This species produces harmful, irritating sticky whitish secretions (McDiarmid, 1968), hence its common name of milk frog. It is also called pepper tree frog because it may stimulate sneezing (Meyer & Foster, 1996). The milky skin secretions protect the individuals against dehydration, frogs even used their secretions to line tree cavities that they use as refuges (Manzanilla, et al. 1998). The skin secretions are also used as a deterrent to predation (Manzanilla et al., 1998).

We found an adult Milk frog fortuitously outside a house at night. We obtained occurrence data of this species from literature (e.g. Savage, 2002; La Marca et al., 2020; Sasa et al., 2010; Duellman et al., 2016; Leenders, 2016). We identified the species on site because this frog is easily separated from any other species in Costa Rica. It lacks vertical dark bars on lips, has uniform flanks, a reticulated pattern of the iris and a glandular skin, characters enough to differentiate this species from similar ones (Savage, 2002; Leenders, 2016). *Smilisca baudinii* lacks glandular skin, a light suborbital spot is usually present, and lips are usually barred (Savage, 2002). *Osteopilus septentrionalis* (which is introduced) has not clearly glandular skin and is only found at the city of Limon on the Caribbean side of Costa Rica (Leenders, 2016). Other hylids found sympatric with Milk frog besides *Smilisca baudinii* are *Scinax staufferi* and *Dendropsophus microcephalus* that are very small (Savage, 2002). Other common medium to large size frogs found on Northwestern Costa Rica are the leptodactylids *Leptodactylus fragilis*, *L. melanonotus*, *L. poecilochilus* and *L. savagei*, and the ranids *Lithobates forreri* and *L. vaillanti* (Sasa et al., 2010). We reviewed 56 records of Milk frog from the Zoology Museum of the University of Costa Rica

(UCR) to obtain data on the altitudinal distribution and life zone occupancy of this species in Costa Rica. In addition, we reviewed records for this species in Central America in the Global Biodiversity Information Facility (GBIF, 2021).

We found a female Milk frog in a glass window after a heavy downpour on 17 July 2021 at 19:20 h (Fig. 1). The house is surrounded by agricultural areas in the community of Rincón, Zaragoza district, Palmares county, Alajuela province (10° 02' 16" N, 84° 27' 13" W; 1145 m elevation; Fig. 2). This locality belongs to the Tropical Premontane Moist Forest (Fig. 2) after the Holdridge life zone system (Holdridge, 1969; Centro Científico Tropical, 1993). The area where we observed the frog is semi-urban and the land is mainly dedicated to the cultivation of coffee, and guava at one nearby plot.

The lowlands of Costa Rica where Milk frog has been recorded are in the Dry, Moist and Wet tropical forest life zones, as well as in the Tropical Premontane Moist Forest, basal transition, the Tropical Premontane Wet Forest, basal transition, and the Premontane Rain Forest, rain transition (Table 1). The highlands of Costa Rica where Milk frog has been recorded (UCR records), are all localities in the Tropical Premontane Rain Forest (Table 1): San Isidro de Dota at 800 m elevation (UCR 21483), Peñas Blancas de San Ramón at 900 m elevation (UCR 18835), Volcán Cacao at 1070 m elevation (UCR 19661), and Bratzi de Talamanca at 1100 m elevation on the Caribbean slope (UCR 9475). Two recent reports from the Coto Brus Valley are from a life zone not previously recorded for Milk frog, Tropical Premontane Rain Forest, Rain transition, at 1092 m elevation (Gómez-Hoyos et al., 2020). Unfortunately, Gómez-Hoyos et al. (2020) did not mention if *T. typhonius* has been known to people at the site or if it may be a recent arrival in the area. Our record is the first one for the Tropical Premontane Moist Forest in Costa Rica.

The distribution of Milk frog in Costa Rica is plain, since it clearly occupies the Pacific lowlands and the lower part of the San Juan River basin in the north of the country (Fig. 2). There are fewer records from the southwestern, but it has been found on the Osa Peninsula. There is a record on the Caribbean slope very isolated from the other points (Fig. 2). However, the species may occur there overpassing the high mountains of Talamanca surrounding the Chiriquí mountain range through Panama, a biogeographical pattern seen on other vertebrate species in Costa Rica (Gómez, 1986). Milk frog was reported recently from the Coto Brus area, near the Panama border, in the Térraba River basin (Gómez-Hoyos et al., 2020). It is striking that at the moment there are no records in the GBIF database from these points in southern of Costa Rica to the center of Panama with

Tabla 1. Número de individuos (#) de *Trachycephalus typhonius* por zonas de vida de Holdridge (LZ) y tipos de bosque (Forest), y ámbito de elevación (m) de los registros en Costa Rica. Se trata de 56 especímenes de la colección del Museo de Zoología de la Universidad de Costa Rica, el nuevo registro presentado en esta nota (*), y dos registros recientes del Valle de Coto Brus (**).

Table 1. Number of individuals (#) of *Trachycephalus typhonius* per Holdridge's life zones (LZ) and forest types (Forest), and elevation range (m) of the records in Costa Rica. These are 56 specimens from the collection of the Zoology Museum, University of Costa Rica, the new record presented in this note (*), and two recent records from Coto Brus Valley (**).

LZ	Forest	m	#
bs-T	Tropical Lowland Dry Forest	55-120	3
bs-T2	Tropical Lowland Dry Forest, moist transition	10	1
bh-T	Tropical Lowland Moist Forest	6-100	9
bh-T2	Tropical Lowland Moist Forest, wet transition	4-120	5
bmh-T	Tropical Lowland Wet Forest	5-280	5
bmh-P6	Tropical Lowland Wet Forest, basal transition	2-300	8
bh-P	Tropical Premontane Moist Forest	1145	*1
bh-P6	Tropical Premontane Moist Forest, basal transition	5-350	18
bmh-P6	Tropical Premontane Wet Forest, basal transition	40	1
bmh-P4	Tropical Premontane Wet Forest, Rain transition	1092	**2
bp-P	Tropical Premontane Rain Forest	800-1100	4

some records in the provinces of Veraguas and Herrera and to the south.

This is the first report for Milk frog in the Central Valley of Costa Rica, but also important is that it is the first report in the Tropical Premontane Moist Forest. The closest site to the new record in Palmares is only about 35 km away, but in the Tropical Moist Forest at only 100 m elevation (UCR 926). However, the distance of 35 km is overcoming the Aguacate mountains from

100 to over 1000 m elevation. In this sense, the record does not extend the known distribution range significantly, furthermore, the record does not stray far from its altitudinal range. However, the record is important due to several reasons. The Central Valley is a region of Costa Rica geographically and culturally separated from the other regions of the country (Gómez, 1986). The best agriculture soils of Costa Rica are found in this intermountain valley as well as the largest human settlements such as the great metropolitan area (Gómez, 1986). As a result, the Central Valley has lost most of its original vegetation cover and its associated animal biodiversity (Sasa et al., 2010; Jankilevich, 2019). In recent years, urban biological corridors have been created and are consolidating in the main cities of the Central Valley (Jankilevich, 2019), which help the permanence and mobilization of animal species. The appearance or reappearance of species such as Milk frog in the Central Valley may be an important biological and environmental indication. Moreover, our record is the first found in the Tropical Premontane Moist Forest, which may imply that the species could be expanding its capacity to inhabit new climatic environments, showing a high resilience. Even if this is not a new arrival, our record is significant because it means that the species persists not only in open areas but also in areas strongly affected by anthropic activities whose amphibian communities were eliminated. It is possible that the species has existed in the Central Valley of Costa Rica but somehow ignored. One of us (MAR) observed a Milk frog in the same area in 2012, but considered it as a common sighting. However, there are no other records from the Central Valley. At least nine frog species were encountered in the Central Valley even after its high urbanization process (Sasa et al., 2010), but this list did not include Milk frog. There are cases of native frog species transplanted within the country through direct human agency or invade new areas as altered habitats create avenues for their dispersal (Sasa et al., 2010). As a result, the appearance of Milk frog in the Central Valley could be one of these cases because it is a winner. Winners might have persisted in low densities in forests, but after habitat conversion to agricultural areas they become more abundant (Pyrón, 2018). Habitat conversion not only create losers, species quickly reduced in abundance or extirpated from natural habitats, but also create winners, species increasing abundance in modified landscapes due to drastic ecological gains (Pyrón, 2018). Milk frog is readily found in open areas but it is scarce in forested habitats (Leenders, 2019). As a result, this species could be a good bioindicator of environmental conditions. Evaluations and explorations are necessary to obtain valid conclusions in terms of distribution and conservation of Milk frog and other species. Continuous monitoring of species and habitats is necessary to

assess the distribution and status of amphibian populations in Costa Rica.

Acknowledgements.– JMM acknowledges Emilce Rivera, Department head, Gestión Ecoturística, Sede Central, and LIL acknowledges Uriel Rojas, Ingeniería en Tecnología de Alimentos, Sede Atenas, both of Universidad Técnica Nacional (UTN), for assigning time to work on this paper.

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