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FIRST RECORD OF ECTROMELIA IN *DRYOPHYTES EXIMIUS* (ANURA: HYLIDAE) FROM CENTRAL MEXICO

PRIMER REGISTRO DE ECTROMELIA EN *DRYOPHYTES EXIMIUS* (ANURA: HYLIDAE) DEL CENTRO DE MÉXICO

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Abstract.– We report the first record of ectromelia (incomplete limb segments) in an individual of *Dryophytes eximius* found in a pine forest of Hidalgo, MExico.

Keywords.– Amphibians, morphological anomalies, abnormality, hylids.

Resumen.– Reportamos el primer registro de ectromelia (segmento de miembro incompleto) en un individuo de *Dryophytes eximius* encontrado en un bosque de pino en Hidalgo, México.

Palabras clave.– Anfibios, anomalías morfológicas, anormalidad, hílidos.

Invertebrates, morphological anomalies imply a lack of symmetry or an imbalance in anatomical stuctures (Lannoo, 2008). Detection and evaluation of these anomalies in amphibians have generated a scientific interest in understandingthe causes and the extrinsic (e.g., UV-B radiation, chemical contaminants, parasites, and predation; Blaustein & Johnson 2003; Barragan-Ramírez & Navarrete-Heredia, 2011; Henle et al., 2017) and intrinsic (outcomes of mutations, developmental errors and trauma, or other kind of diseases; Johnson et al., 2002; Blaustein & Johnson 2003) factors that promote them.

Meteyer (2000) described over 20 different types of morphological abnormalities in anurans, mainly in species or populations that inhabit anthropized areas, including agricultural lands, suburban or modified sites, and polluted aquatic systems (Ouellet et al., 1997; Johnson et al., 2003; Peltzer et al., 2011; Aguillón-Gutiérrez & Ramírez-Bautista, 2015). Records of malformed frogs have been increasing since 1990 (Stocum, 2000) and together with the global decline of amphibian populations are of great concern considering the current biodiversity crisis and increasing of infectious diseases (Blaustein & Johnson, 2003).

The most common morphological anomalies in anurans are complete or partial missing limbs (Gardiner & Hoppe, 1999; Johnson et al., 2002; Peltzer et al., 2011; Ramírez-Jaramillo, 2019). Usually, individuals with limb anomalies have impaired locomotor performance, which makes them more prone to predation than those with fully-formed limbs (Johnson et al., 1999, 2006). Ectromelia (incomplete limb segments; Meteyer, 2000) has been reported in different Mexican anurans, such as *Lithobates neovolcanicus* (Barragan-Ramírez & Navarrete-Heredia, 2011), *Dryophytes plicatus* (Aguillón-Gutiérrez & Ramírez-Bautista, 2015), and *Craugastor rhodopis* (Díaz-García et al., 2019). The potential causes of this anomaly are exposure to pollutants like heavy metals (Aguillón-Gutiérrez & Ramírez-Bautista, 2015), pesticides (Ouellet et al., 1997), and parasite infection of the trematode *Ribeiroia* (Johnson et al., 1999, 2002).

Dryophytes eximius (Baird, 1854) is a Mexican endemic anuran species, occurring in South Central Durango, Sierra Madre Oriental (southern Tamaulipas), and Transmexican Volcanic Belt (across Jalisco, Colima, Michoacán, Estado de México, Morelos, Ciudad de México, Puebla, Hidalgo, and Veracruz; Frost, 2023). This species can be found in a variety of upland habitats, such

as pine forests at elevations between 900 and 2900 m a.s.l. (Duellman, 2001); however, it can also be found in courtyards, abandoned areas, and sewers (Ramírez-Bautista et al., 2023). *Dryophytes eximius* is considered by international policies (e.g., IUCN red list of threatened species; IUCN, 2020) in the least concern category, but not in a risk category by national laws (e.g., NOM-059-2010; SEMARNAT, 2019).

Here we report the first record of a limb anomaly in *D. eximius*. On 10 September 2022 at 14:30 h, we captured an adult male of *D. eximius* near to a pond in a pine forest in the locality of Canta Ranas, Municipality of Santiago Tulantepec, Hidalgo, Mexico (19.9867281°N, 98.3644809°W, WGS84, 2623 m a.s.l.). The snout-vent length (SVL) and body mass (BM) of the individual were measured with a digital caliper (± 0.01 mm) and a spring balance (± 0.25 g Pesola ®), respectively. This adult male (SVL: 30.70 mm, BM: 2.1 g) had the right humerus incomplete and total absence of the radio-ulna bones (Fig. 1). We identified this anomaly as ectromelia according to Meteyer (2000). The individual was released in the capture site after being measured, weighed, and photographed. The pictures of this record were deposited in the digital collection of the Natural History Museum of Los Angeles, California (LACM PC-3011-3012).

This represents the eighth record of anomaly in Mexican hylid frogs (Venerozo-Tlazalo et al., 2022), and the first reported in the state of Hidalgo. Records of ectromelia in other hylids species, such as *Pseudacris regilla* (Johnson et al., 1999) and *D. plicatus* (Aguillón-Gutiérrez & Ramírez-Bautista, 2015), have been associated with exposition to parasites and heavy metals. Given their specific characteristics (e.g., permeable skin, as well as terrestrial and aquatic lifestyle), hylids are good bioindicators of environmental health (Zaghloul et al., 2020). The increase in the frequency of morphological abnormalities is potentially related to habitat degradation (Díaz-García et al., 2019), including but not limited to water pollution, increasing ultraviolet radiation, and parasitic infection (Blaustein & Johnson, 2003). There is evidence that malformed individuals have an elevated mortality rate (Johnson et al., 2006), given that *D. eximius* is a semiaquatic species, the ectromelia might diminish its swimming and jumping capacities, which in turn could affect its reproductive success and survival probability (Ouellet et al., 1997), which negatively affects population persistence (Blaustein & Johnson, 2003). It is important to note that the study area has no conservation status, and it is even surrounded by agroecosystems (where agrochemicals are used) which could explain the presence of this morphological anomaly in this frog.

Finally, we consider that evaluation of environmental stressors and surrogates of habitat degradation, such as anomalies, can provide valuable information in the early detection of extinction threats to amphibians at individual and population level related with environmental stressors and intrinsic characteristics of the species such as genetic diversity. Hence, actions such as continuous monitoring of amphibian population parameters in disturbed environments, with special attention to those where

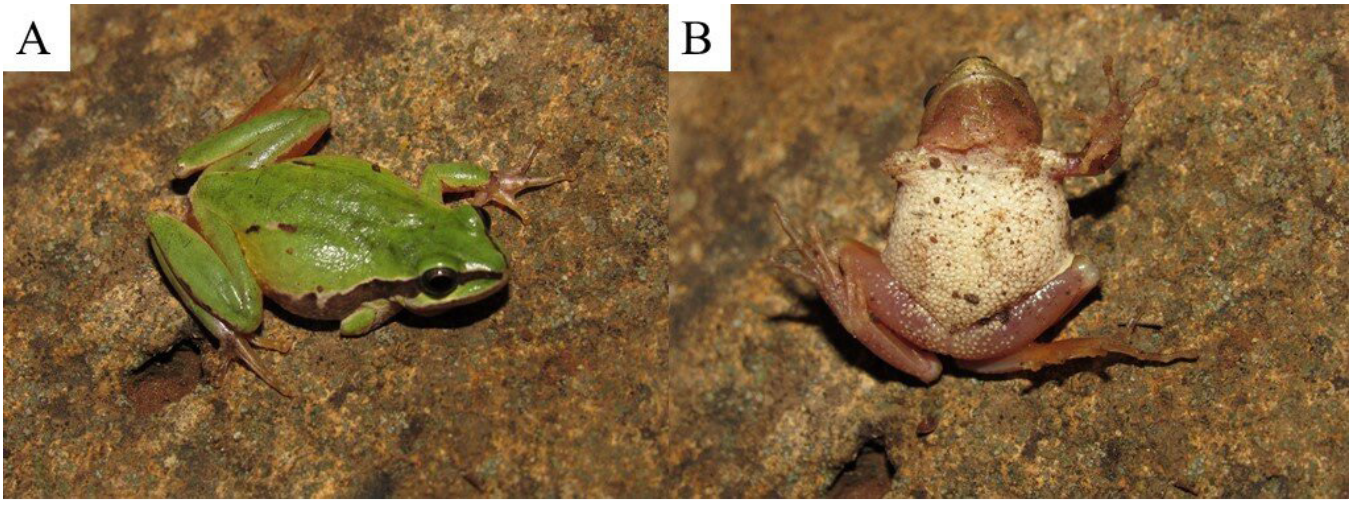

Figura 1. Vista dorsal (A) y ventral (B) de macho adulto de *Dryophytes eximius* con ectromelia (segmento de miembro incompleto) en la extremidad anterior derecha, encontrado cerca de un estanque en un bosque de pino en Hidalgo, México. Fotos: César A. Díaz-Marín (LACM PC-3011-3012).

Figure 1. Dorsal (A) and ventral (B) view of adult male of *Dryophytes eximius* with ectromelia (incomplete limb segment) in the right anterior limb, found near to a pond in a pine forest in Hidalgo, Mexico. Pictures: César A. Díaz-Marín (LACM PC-3011-3012).

there is a considerable incidence of morphological anomalies, would enhance our knowledge of amphibian population status and environmental quality.

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