

First records of anophthalmia in the Gulf coast toad *Incilius nebulifer* Girard 1854 (Anura, Bufonidae) observed in Puebla, Mexico

Primeros registros de anoftalmia en el sapo de la costa del Golfo *Incilius nebulifer* Girard 1854 (Anura, Bufonidae) observados en Puebla, México

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Abstract. Morphological anomaly reports in amphibians have increased in Mexico in the last decade, being the Ambystomatidae and Hylidae species those that have the greatest number of records. We reported the first two cases of anophthalmia (absence of eye) in the Gulf coast toad *Incilius nebulifer* observed in the localities of Cuetzalan del Progreso and Tuxtla in the Sierra Nororiental de Puebla, Mexico.

Keywords: Cloud forest, morphological abnormalities, Sierra Nororiental de Puebla

Resumen. Los reportes de anomalías morfológicas en anfibios han aumentado en México en la última década, siendo las especies de las familias Ambystomatidae e Hylidae las que presentan el mayor número de registros. En esta nota, reportamos los primeros dos casos de anoftalmia (ausencia de ojo) en el sapo de la costa del Golfo *Incilius nebulifer* observados en las localidades de Cuetzalan del Progreso y Tuxtla en la Sierra Nororiental de Puebla, México.

Palabras clave: Bosque de niebla, anomalías morfológicas, Sierra Nororiental de Puebla

A morphological anomaly is defined as an alteration in the anatomy of individuals (Venerozo-Tlazalo et al. 2022), that can be caused by mutations, errors in embryonic development or trauma during this stage, attacks by predators, parasitic infections, exposure to chemical pollutants or ultraviolet radiation (Meteyer 2000, Peltzer et al. 2001). Morphological anomalies in amphibians mainly affect the extremities, phalanges, and eyes (Meteyer 2000, Venerozo-Tlazalo et al. 2022).

In anurans, the most frequent anomalies are amelia (absence of any limb), anophthalmia (absence of one or two eyes), brachydactyly (disproportionately short phalanges), polydactyly (presence of more

metatarsal bones), and microcephaly (head size reduced; Meteyer 2000, Morales-Flores et al. 2021, Beltrán-Alvarez 2023). In the last decade, anomaly reports in amphibians have increased in Mexico (Venerozo-Tlazalo et al. 2022), more frequently in anurans than in salamanders. In Mexico, the Ambystomatidae and Hylidae families are the ones with the highest number of reported cases of anomalies (Cante-Bazán and Ramírez-Bautista 2023).

Incilius nebulifer Girard 1854 is a widely distributed toad through eastern Coahuila, Nuevo Leon, San Luis Potosi and Tamaulipas to Hidalgo, Puebla and central Veracruz, Mexico and the southeastern United States (Frost 2024). *I. nebulifer* is a species with

generalist habits since it has been reported in human settlements, agricultural crops, livestock pastures, shaded coffee plantations and secondary forests (Díaz-García et al. 2024). This species is listed as Least Concern with a stable population trend (IUCN SSC Amphibian Specialist Group 2021). In this note, we present the first two cases of anophthalmia in *I. nebulifer* recorded in the Sierra Nororiental de Puebla, Mexico.



Figure 1: (A) Frontal view of an adult individual of *Incilius nebulifer* with anophthalmia (left eyeball absent) recorded in the Cuetzalan del Progreso, Puebla, Mexico (LACM PC 3036). Frontal (B) and lateral (C) view of an adult individual of *I. nebulifer* with anophthalmia recorded in Tuxtla, Puebla, Mexico (LACM PC 3037–3038). Photographs: Alan Emir Díaz Félix (A) and Daniel Joaquín Sánchez Ochoa (B and C). **Figura 1:** (A) Vista frontal de un individuo adulto de *Incilius nebulifer* con anofthalmia (sin globo ocular izquierdo) registrado en Cuetzalan del Progreso, Puebla, México (LACM PC 3036). Vista frontal (B) y lateral (C) de un individuo adulto de *I. nebulifer* con anofthalmia registrado en Tuxtla, Puebla, México (LACM PC 3037-3038). Fotografías: Alan Emir Díaz Félix (A) y Daniel Joaquín Sánchez Ochoa (B y C).

On October 8, 2022, at 14:06 h, we found an adult individual of *Incilius nebulifer* (Snout-vent length [SVL] = 79.8 mm) with the left eyeball absent and the eyelid present (Fig. 1A), on a trail covered with leaf litter and surrounded by herbaceous plants in a cloud forest fragment. This record occurred during a diurnal sampling of amphibian populations at the Cuetzalan Cloud forest Amphibian Sanctuary, in the locality of Cohuatichan, Cuetzalan del Progreso, Puebla, Mexico (19°59'30.49" N, 97°31'17.90" W, WGS84, 1.142 m.).

On September 17, 2023, at 23:08 h, we found an adult individual of *I. nebulifer* (SVL = 75.3 mm, weight = 44.9 g) with the left eyeball absent and the eyelid present (Fig. 1B, C) in Tuxtla, Zapotitlan de Mendez, Puebla, Mexico (Fig. 2). The individual was jumping on a pavement road on the periphery of the locality and near to shade-coffee plantations and crops (20° 0'6.48" N, 97°39'2.52" W, WGS84, 1.033 m.). This record occurred during the amphibian samplings of the research project “Taxonomic diversity and traditional ecological knowledge of amphibians in a Tutunakú indigenous municipality of the Northeastern Sierra of Puebla,

Mexico”, in which we recorded 34 toads of the *I. nebulifer* species without morphological anomalies between June to October 2023 (Díaz-García et al. 2024).

We captured both toads using nitrile gloves to photograph them. We released them immediately at the same capture site. We registered the photographs in the digital collection of the Natural History Museum of Los Angeles, California (LACM PC 3036 – 3038). The two morphological anomalies cases were identified as anophthalmia, according to Meteyer (2000). These records are the first reports of anophthalmia in *I. nebulifer* and the fifth and sixth cases of anophthalmia reported in Mexican amphibians (Venerozo-Tlazalo et al. 2022; Cante-Bazán and Ramírez-Bautista 2023).

Anophthalmia in Bufonidae toads has only been reported in *Incilius occidentalis* (Castro-Torreblanca and Blancas-Calva 2021). In Mexico, there is only one reported case of anophthalmia in the anuran *Smilisca baudinii* (Hernández-Jáuregi et al. 2021), while there are two reports in the salamander species *Bolitoglossa platyductyla* (Venerozo-Tlazalo et al. 2022) and *Pseudoeurycea leprosa* (Cante-Bazán and Ramírez-Bautista 2023). This type of anomaly may cause alterations in the behavior and survival of amphibians due to the absence of a visual organ affects courtship and territoriality (Toledo et al., 2007). However, this information should be taken with caution due to the low registration rate of anophthalmia in *I. nebulifer* (0.02) that we reported, at least, in the population of Tuxtla, Puebla.

It's interesting that both records occurred in the Sierra Nororiental de Puebla, Mexico, separated with a linear distance of 13.5 km. The original vegetation in this region is the cloud forest, however, it has been highly transformed to human settlements, cattle pastures, shade-coffee plantations and crops (Basurto-Peña et al. 1998). Possibly the conversion of the cloud forest to agricultural land uses exposes amphibians to agrochemicals in this region, but we cannot verify this cause of anophthalmia with only two occasional reports. Reports on morphological anomalies in amphibians may be useful for future research interested in relieving the factors that cause them.

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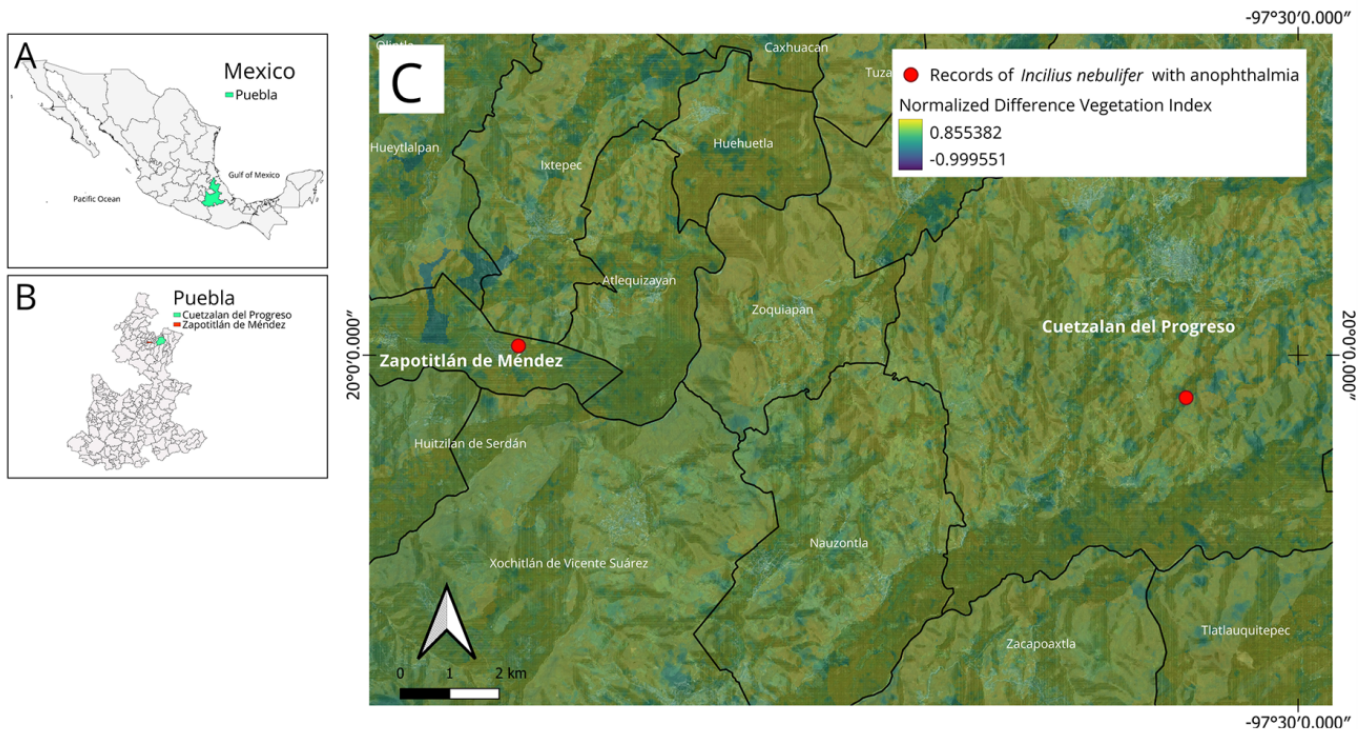


Figure 2: Location of anophthalmia records in the Gulf coast toad *Incilius nebulifer* in Puebla, Mexico. Prepared by Perla Isabel Pacheco Méndez using the Normalized Difference Vegetation Index (NDVI; MX_017011) Landsat 8.9 map (INEGI, 2024). Figura 2: Ubicación de los registros de anofthalmia en el sapo de la costa del Golfo *Incilius nebulifer* en Puebla, México. Elaborada por Perla Isabel Pacheco Méndez utilizando el Índice de Vegetación de Diferencia Normalizada (NDVI; MX_017011) del mapa Landsat 8.9 (INEGI, 2024).

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