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Ocular anomaly in the Plateau Toad, *Anaxyrus compactilis* (Wiegmann, 1833), from Jalisco State, West-Central Mexico

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Morphological anomalies are defined as deviations from the typical range of morphological variation based on external anatomical analysis (Henle et al., 2017). These can result from mutations, embryonic development failures, or trauma at this stage (Henle et al., 2017; Sánchez-Domene et al., 2018; Venerozo-Tlazalo et al., 2022), exposure to agrochemicals (Lajmanovich et al., 2012), exposure to heavy metals, such as lead and iron (Aguillón-Gutiérrez and Ramírez-Bautista, 2015), predation (Sessions and Ballengeé, 2010), or parasitism (Johnson et al., 2006; Densmore and Green, 2007).

Different types of morphological anomalies have been reported in amphibians, such as polymely (additional limb or parts of it; Rothschild et al., 2012; Oser et al., 2023), polydactyly (increased number of fingers; Cruz-Pérez et al., 2009; Rothschild et al., 2012), ectromelia (partial or total absence of a limb; Rothschild et al., 2012; Díaz-García and Reyes-Servín, 2023; Olvera-Mendoza et al., 2023), ectrodactyly (partial or total absence of one or more digits; Rothschild et al., 2012; Carmona-Zamora et al., 2020), tail bifurcation (a tail with two or more points; Hernández-Jiménez et al., 2024), anophthalmia (absence of one or both eyes; Brassaloti and Bertoluci, 2018; Morales-Flores et al., 2021), microphthalmia (reduction of one or both eyes; Meteyer, 2000; Díaz-García et al., 2019), heterochromia (iris of one or both eyes of different colour; Álvarez et al., 2023), and black eyes (absence of the pupil's iris; Cortés-Suárez et al., 2021; Pedroso-Santos et al., 2022). These anomalies have been observed in various groups of amphibians worldwide (Meteyer, 2000; Rothschild et al., 2012). According to Venerozo-Tlazalo et al. (2022), different anomalies have been reported in six families of amphibians in Mexico. The family Hylidae had the highest frequency incidence (35.3%), followed by the families Ambystomatidae (17.6%), Ranidae (17.6%), Bufonidae (11.8%), Plethodontidae (11.8%), and Craugastoridae (5.9%).

Anaxyrus compactilis (Wiegmann, 1833), is a toad species that is distributed from Durango to Jalisco, extending through the southern edge of the Transverse Volcanic Range across Michoacán, Mexico State, Guanajuato, Querétaro, Morelos, Puebla, and Veracruz (Dixon and Lemos-Espinal, 2010). This species inhabits elevations from 1500 to 2900 m and is typically found in mesquite grasslands and open environments (Dixon and Lemos-Espinal, 2010). During sampling of the Mountain Treefrog (*Dryophytes eximius*) populations, on 19 June 2024, at approximately 01:11 h, an adult male *A. compactilis* (snout-vent length: 63.35 mm; body mass: 24.5g; Fig. 1), was found in a cavity of mud near the water of La Tinaja dam (20.3567°N, 103.1058°W; 1640 m elevation), located in the town of San Juan Tecomatlán, municipality of Poncitlán, Jalisco, where the main vegetation type is tropical deciduous forest (Rzedowski, 2006). The individual presented an enlarged and abnormally pigmented right eyeball. Once the eye of the specimen was photographed, the toad was placed in the same location. It is worth noting that whilst photographing the abnormal eye, we noticed that the specimen repeatedly turned its normal eye towards the person who was taking the photograph at that moment. Pedroso-Santos et al. (2022) observed the same anomaly and behaviour in an amphibian belonging to the genus *Osteocephalus*. The authors observed that when one of them stood behind the frog and moved the hand parallel to the left side of the frog (with the normal eye), the frog tended to change its position. When this movement was

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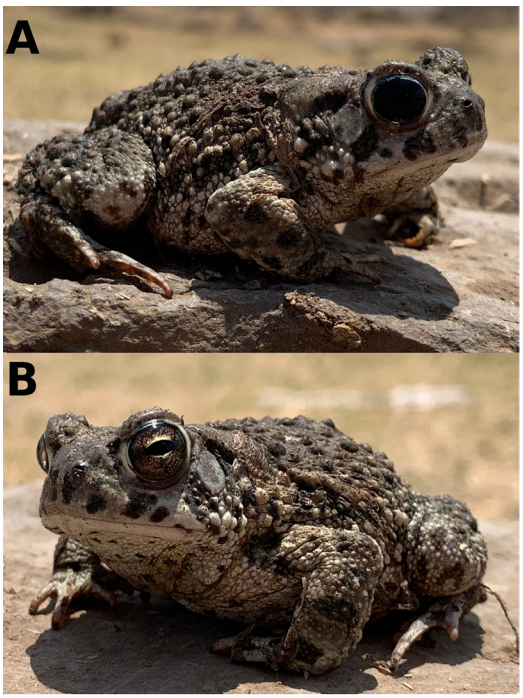

Figure 1. (A) Right side with ocular anomaly, (B) Left side with normal eye. Photos by Rodolfo Guzmán-Ramírez.

made on the right side of the frog (with the black eye), the individual did not react, suggesting some degree of vision loss. It has been suggested that the absence or low vision in anurans may cause an inability to perceive potential predators, and therefore, may affect their survival (Pedroso-Santos et al., 2022).

According to Henle et al. (2017), this ocular anomaly is known as "black eyes" and is considered a subcategory of heterochromia. Dubois (1976) pointed out that this is caused by the lack of chromatophores (pigment cells responsible for skin colouration and eye colour in ectothermic animals and the development of the neural crest throughout embryonic development). Hybridisation experiments with *Pelophylax esculentus* (Rostand and Darre, 1970) have shown that this anomaly is determined by a recessive mutation (Rostand, 1953). According to Dubois (1979), the frequency of occurrence of this anomaly is 0.2% over an eleven-year period, and it can be observed mainly in post-metamorphic juveniles, as in the case of the *P. esculentus* complex.

Based on the above, this report represents the first record of the black eye anomaly in an amphibian endemic to Mexico. This finding highlights the need to monitor the health of amphibians in the study area, as this anomaly could indicate environmental stress and changes in the habitat quality of *A. compactilis* populations, induced by pollutants due to anthropogenic activities such as agriculture and livestock farming (IIEG, 2012; Salinas, 2021; Torres-Sánchez et al., 2024).

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