



# Malformations in the Mexican Leaf Frog, *Agalychnis dacnicolor* Cope 1864 (Anura: Phyllomedusidae), from Sinaloa, Mexico

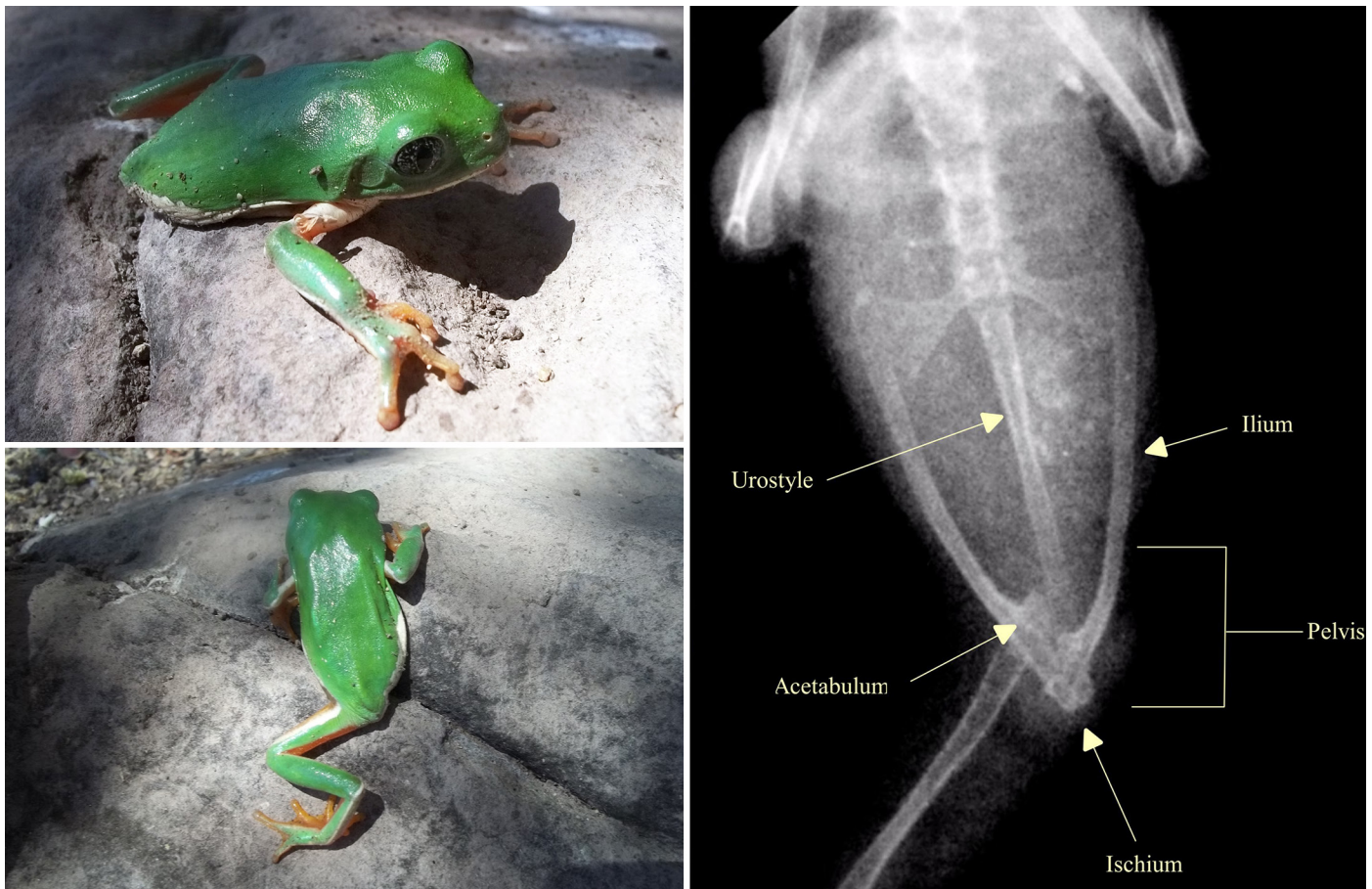
Daniela Lilibeth Morales-Lugo<sup>1</sup>, María Fernanda Loaiza-Cebreros<sup>1</sup>, Héctor Alexis Castro-Bastidas<sup>2</sup>, and Marcos Bucio-Pacheco<sup>1,2</sup>

<sup>1</sup>Facultad de Biología, Universidad Autónoma de Sinaloa, Culiacán 80013, Sinaloa, México

<sup>2</sup>Centro de Estudios “Justo Sierra” (CEJUS), Badiraguato 80600, Sinaloa, México (alexizbastidas@gmail.com)

Abnormalities in amphibians have generated interest in the scientific community among those who seek to determine whether the causes are anthropogenic or not. Abnormalities fall into two main categories: malformations that consist of permanent structural defects resulting from abnormal development, and deformities that are disturbances of a properly formed structure (Meteyer 2000). Some factors

that have been recognized and questioned as causing these abnormalities are infestation by parasites, environmental contaminants, selective predation, inbreeding, and high levels of ultraviolet radiation (Aguillón-Gutiérrez 2018). Even though some etiological agents are common, few studies have been published on these abnormalities in Mexico (Venerozo-Tlazalo et al. 2022).



**Fig. 1.** A juvenile Mexican Leaf Frog (*Agalychnis dacnicolor*) missing its right hindlimb (left) and a radiograph of the individual showing incomplete development of the pelvis (right). Photographs by Héctor Alexis Castro Bastidas; radiograph courtesy of Dr. Erika de Lourdes Silva Benítez.

The Mexican Leaf Frog (*Agalychnis dacnicolor*) is a species endemic to elevations below 1,000 m that inhabits tropical or subtropical dry forests (Duellman 2001). It is distributed from the Pacific lowlands of Mexico in southern Sonora and southwestern Chihuahua, to the Isthmus of Tehuantepec (including the Balsas depression to the state of Mexico; Frost 2021). This is a species in Mexico that is not listed in NOM-059-SEMARNAT-2010 (SEMARNAT 2010) and its international conservation status in the IUCN Red List is in the category of Least Concern (IUCN SSC Amphibian Specialist Group 2020).

The present work derives from an encounter with a juvenile *A. dacnicolor* (39.3 mm SVL), during a field trip on 16 March 2022 in the village of Walamitos, Culiacán, Sinaloa. The individual was found around 2217 h on the edge of a pond surrounded by an area disturbed by recreational activities (24.373139 °N, 107.034033 °W; elev. 141 m asl). During the review of the individual, it presented complete absence of the right hindlimb (RHL; Fig. 1); unfortunately, the individual passed away in the field. The specimen was preserved and later deposited in the Laboratorio de Zoología of the Facultad de Biología of the Universidad Autónoma de Sinaloa (UAS). The photographs generated of the specimen in life and postmortem were deposited in the herpetological digital collection of the Natural History Museum of Los Angeles (LACM PC: 2895-900) and in the Colección Nacional de Anfibios y Reptiles of the Instituto de Biología of the Universidad Nacional Autónoma de México (UNAM) (CNAR-RF: 747a-e).

Laboratory examination showed that the damage was due to malformation and not trauma; for this reason, ventral and dorsal radiographs were taken. Based on the manual of Meteyer (2000), the type of abnormality present in the affected limb was determined. The RHL malformation corresponded to amelia, a type of ectromelia which is defined as the complete absence of a limb structure. Moreover, the radiography revealed incomplete pelvic development (Fig. 1), specifically a slight deviation of the ischium, both acetabula, and urostyle, affecting the position of the right ilium.

We lack scientific evidence to explain the origin of this malformation. However, some studies suggest that environmental retinoids, such as those produced by cyanobacteria or toxic products such as herbicides, may interfere with the action of retinoic acid and vitamin A, which are believed to have an important influence on the correct development of limbs in anurans (Gardiner and Hoppe 1999; Das and Mohanty-Hejmadi 2000; Paganelli et al. 2010; Wu et al. 2012). We recommend an increase in field work for the monitoring of amphibians in the state of Sinaloa with special emphasis on malformations. This is justified by the scarce

data on the subject and a previous outbreak of ranavirus (Saucedo et al. 2019).

### Acknowledgments

Our gratitude goes to Dr. Erika de Lourdes Silva Benítez and C.D. Rebeca Alvarado Aguirre from the postgrado de Endodoncia of the Facultad de Odontología (UAS) for taking radiographs. Also, to Ricardo Palacios Aguilar for verifying the species, to Nefalí Camacho (LACM) and Víctor Reynoso (UNAM) for cataloging the photographs, to Gustavo Campillo García for providing us with some photographs of a skeleton of the same species reported in this work, as well to Javier Cortés Suárez and Marisol Castro Torreblanca for their advice in preparing this report. Thank you to the Facultad de Biología of the UAS, for having sponsored the practice to the field.

### Literature Cited

- Aguillón-Gutiérrez, D.R. 2018. Anomalías macroscópicas en larvas de anfibios anuros. *Revista Latinoamericana de Herpetología* 1: 8–21. <https://doi.org/10.22201/fc.25942158e.2018.1.12>.
- Das, P. and P. Mohanty-Hejmadi. 2000. Vitamin A mediated limb deformities in the common Indian toad, *Bufo melanostictus* (Schneider). *Indian Journal of Experimental Biology* 38: 258–264.
- Duellman, W.E. 2001. *The Hylid Frogs of Middle America*. Society for the Study of Amphibians and Reptiles, Ithaca, New York.
- Frost, D.R. 2021. *Amphibian Species of the World: An Online Reference*. Version 6.1. American Museum of Natural History, New York, New York, USA. <<https://amphibiansoftheworld.amnh.org/index.php>>.
- Gardiner, D.M. and D.M. Hoppe. 1999. Environmentally induced limb malformations in mink frogs (*Rana septentrionalis*). *Journal of Experimental Zoology* 284: 207–216. [https://doi.org/10.1002/\(SICI\)1097-010X\(19990701\)284:2<207::AID-JEZ10>3.0.CO;2-B](https://doi.org/10.1002/(SICI)1097-010X(19990701)284:2<207::AID-JEZ10>3.0.CO;2-B).
- IUCN SSC Amphibian Specialist Group. 2020. *Agalychnis dacnicolor*. *The IUCN Red List of Threatened Species* 2020: e.T55813A53959492. <https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T55813A53959492.en>.
- Meteyer, C.U. 2000. Field guide to malformations of frogs and toads with radiographic interpretations. Biological Science Report 2000–0005. U.S. Geological Survey, Reston Virginia, USA.
- Paganelli, A., V. Gnazzo, H. Acosta, S.L. López, and A.E. Carrasco. 2010. Glyphosate-based herbicides produce teratogenic effects on vertebrates by impairing retinoic acid signaling. *Chemical Research in Toxicology* 23: 1586–1595. <https://doi.org/10.1021/tx1001749>.
- Saucedo, B., J.M. Serrano, M. Jacinto-Maldonado, R.S.W.E. Leuven, A.A. RochaGarcía, A. Méndez-Bernal, A. Gröne, S.J. van Beurden, and C.M. Escobedo-Bonilla. 2019. Pathogen risk analysis for wild amphibian populations following the first report of a ranavirus outbreak in farmed American Bullfrogs (*Lithobates catesbeianus*) from northern Mexico. *Viruses* 11: 26. <https://doi.org/10.3390/v11010026>.
- SEMARNAT. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, para la Protección ambiental-Especies nativas de México de flora y fauna silvestre-Categoría de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario Oficial de la Federación, México.
- Venerozo-Tlázalo, D.G., V. Vásquez-Cruz, D. Medina-Nogueira, and J.A. de la Rosa-Pérez. 2022. Lista actual de anomalías morfológicas en anfibios mexicanos, con dos casos nuevos en el centro-oeste del estado de Veracruz. *Revista Latinoamericana de Herpetología* 5: 15–21. <https://doi.org/10.22201/fc.25942158e.2022.1.268>.
- Wu, X., J. Jiang, Y. Wan, J.P. Giesy, and J. Hu. 2012. Cyanobacteria blooms produce teratogenic retinoic acids. *Proceedings of the National Academy of Sciences* 109: 9477–9482. <https://doi.org/10.1073/pnas.1200062109>.