REPTILES & AMPHIBIANS

First Report of Anophthalmia in Rivero's Toad, *Rhinella humboldti* (Gallardo 1965) (Anura: Bufonidae), in Colombia

Luis A. Olivera[1], Jhesteiner Julio-Dávila[2], Manuel de Luna[3], Oswaldo Peña-Contreras[2], and José Alvis[4]

[1]Federal University of Paraná, Av. Cel. Francisco H. dos Santos, 100 - Jardim das Américas, Curitiba - PR, 81530-000, Curitiba, PR, Brazil (luis.olivera@ufpr.br)
[2]Grupo de Investigación Biología Evolutiva, Facultad de Educación y Ciencias, Programa de Biología, Universidad de Sucre, Sincelejo, 700001 Sucre, Colombia
[3]Facultad de Ciencias Forestales, Universidad Autónoma de Nuevo León, Carretera a Ciudad Victoria km 145, C.P. 67700, Linares, Nuevo León, México
[4]Independent researcher, Chinú, Córdoba, Colombia

A malformation in anurans called anophthalmia is defined by the complete absence of one or both eyes (Meteyer 2000) and is relatively common in some hylids (Souza et al. 2021). This condition has been observed in a variety of invertebrate (Galán et al. 2014) and vertebrate taxa, from fish to mammals, with the majority of the accounts emanating from Europe and North America (Gray and Lethaby 2010; Henle et al. 2012; Reeves et al. 2013; Castro-Torreblanca and Blancas-Calva 2021; Venerozo-Tlazalo et al. 2022), with sparse records in Central (Bland and Mclaren 2023) and South America (Ramalho et al. 2017). This phenomenon has rarely been reported in Colombia, compared to Mexico and Brazil, where lists and new reports of morphological anomalies in anurans have been published (Ramalho et al. 2017; Venerozo-Tlazalo et al. 2022). The first case of anophthalmia in Colombia (Sierra-Serrano et al. 2023) was recorded in an adult Common Marshfrog (*Lithobates vaillanti*) from the Parque Natural de Altamira Refugio in the Department of Sucre.

At 1000 h on 15 May 2023, during a nocturnal sampling event around a camp located in Calle Larga Municipality of Planeta Rica, Department of Cordoba, Colombia (8.3997 N, 75.6164 W), we found an adult *Rhinella humboldti* that was missing its left eye (Fig. 1). Habitat consisted of wooded pastures with evidence of human activities. The toad was examined, photographed, and released during the same night at the site where it was found. No morphometric data were collected. This is the first report of anophthalmia in a

Figure 1. Frontal and lateral views of an adult Rivero's Toad (*Rhinella humboldti*) with anophthalmia. Photographs by Luis A. Olivera.

Reptiles & Amphibians ISSN 2332-4961
https://doi.org/10.17161/randa.v31i1.21348

Colombian bufonid. *Rhinella humboldti* is a common species in Colombia (Cochran and Goin 1970; Ruiz-Carranza et al. 1996; Narvaes and Trefaut-Rodrigues 2009; Acosta-Galvis 2012; Ovalle-Pacheco et al. 2019), where it has an elevational distribution from sea level to 1,015 m asl and where it breeds in temporary ponds, laying between 4,000 and 5,000 eggs in a chain (Guayara and Bernal 2012).

Anophthalmia is one of the most common anomalies in amphibians and is known to have a significant impact on the development and survival of individuals (Ingle 1976; Ramalho et al. 2017; Souza et al. 2021). Some studies have addressed the effects of anophthalmia in some amphibians (Aguillón-Gutiérrez 2018), but causes and effects in other species, such as the salamander, *Bolitoglossa platydactyla*, have not been determined (Venerozo-Tlazalo et al. 2022). During courtship, anurans rely both on sight and hearing (Toledo et al. 2007), and typically rely on sight to hunt prey and avoid predators; consequently, this malformation likely reduces fitness and could have a significant effect on survival (Ingle 1976).

Rates of malformations, including anophthalmia, appear to be increasing in anurans (Schoff et al. 2003; Lannoo 2008), which could indicate degradation of the environmental health of ecosystems (Ouellet et al. 1997; Roy 2002). Malformations have been attributed to mutations and errors or trauma during embryonic development (Soto-Rojas et al. 2017). Triggers could include UV light (Blaustein and Johnson 2003; Ankley et al. 2004), parasitic infections (Johnson et al. 2002; Johnson and Lunde 2005; Rajakaruna et al. 2008), damage from predation (Lannoo 2008; Reeves et al. 2008), hybridization (Berger and Uzzel 1977; Haddad et al. 1990; Mable and Rye 1992), inbreeding (Williams et al. 2008; Toledo and Ribeiro 2009), and environmental contaminants such as heavy metals, pesticides, and hydrocarbons (Hayes 2005; Robles-Mendoza et al. 2009; Bacon et al. 2013).

Acknowledgements

We thank the company Diaz & Figueroa Soluciones Ambientales y Civiles S.A.S. for financing our fieldwork.

Literature Cited

Acosta-Galvis, A.R. 2012. Anfibios de los enclaves secos del área de influencia de los Montes de María y la ciénaga de La Caimanera en el Departamento de Sucre. *Revista Biota Colombiana* 13: 211–231. http://doi.org/10.15472/lvx2kr.

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.

Ankley, G.T., S.J. Degitz, S.A. Diamond, and J.E. Tietge. 2004. Assessment of environmental stressors potentially responsible for malformations in North American anuran amphibians. *Ecotoxicology and Environmental Safety* 58: 7–16. https://doi.org/10.1016/j.ecoenv.2004.01.004.

Bacon, J.P., C.E. Fort, B. Todhunter, M. Mathis, and D.J. Fort. 2013. Effects of multiple chemical, physical, and biological stressors on the incidence and types of abnormalities observed in Bermuda's cane toads (*Rhinella marina*). *Journal of Experimental Zoology* 320: 218–237. https://doi.org/10.1002/jez.b.22496.

Berger, L. and T. Uzzell. 1977. Viability and growth of progeny from different egg size classes of *Rana esculenta* L. (Amphibia, Salientia). *Zoologica Poloniae* 26: 292–317.

Bland, A.W. and E.J. Mclaren. 2023. Unilateral anophthalmia in a recently metamorphosed blue-sided leaf frog *Agalychnis annae* in Costa Rica. *Herpetological Bulletin* 164: 41–42. http://dx.doi.org/10.33256/hb164.4142.

Blaustein, A.R. and P.T.J. Johnson. 2003. The complexity of deformed amphibians. *Frontiers in Ecology and the Environment* 1: 87–94. https://doi.org/10.1890/1540-9295(2003)001[0087:TCODA]2.0.CO;2.

Castro-Torreblanca, M. and E. Blancas-Calva. 2021. Anophthalmia in a juvenile Pine Toad, *Incilius occidentalis* (Anura: Bufonidae), from Laguna de Tixtla, Guerrero, Mexico. *Reptiles & Amphibians* 28: 22–23. https://doi.org/10.17161/randa.v28i1.15284.

Cochran, D.M. and C.J. Goin. 1970. Frogs of Colombia. *Bulletin of the United States National Museum* 288: 1–655. https://doi.org/10.5479/si.03629236.288.1.

Galán, C., J.M. Rivas and M. Nieto. 2014. *Minas y Cuevas de Elama (Artikutza): Hidrogeoloía, Fauna y Evolución*. Laboratorio de Bioespeleología, Sociedad de Ciencias Aranzandi, San Sebastián (Guipúzcoa), Spain.

Gray, B.S. and M. Lethaby. 2010. Observations of limb abnormalities in amphibians from Erie County, Pennsylvania. *Journal of Kansas Herpetology* 35: 14–16.

Haddad, C.F.B., A.J. Cardoso, and L.M. Castanho. 1990. Hibridacao natural entre *Bufo ictericus* e *Bufo crucifer* (Amphibia: Anura). *Revista Brasileña de Biologia* 50: 739–744.

Hayes, T.B. 2005. Welcome to the revolution: Integrative biology and assessing the impact of endocrine disruptors on environmental and public health. *Integrative and Comparative Biology* 45: 321–329. https://doi.org/10.1093/icb/45.2.321.

Henle, K., B. Mester, S. Lengyel, and M. Puky. 2012. A review of a rare type of anomaly in amphibians, tail duplication and bifurcation, with description of three new cases in European species (*Triturus dobrogicus*, *Triturus carnifex*, and *Hyla arborea*). *Journal of Herpetology* 46: 451–455. https://doi.org/10.1670/11-176.

Ingle, D. 1976. Spatial vision in anurans, pp. 119–140. In: K.V. Fite (ed.), *The Amphibian Visual System: A Multidisciplinary Approach*. Academic Press, New York, New York, USA.

Johnson, P.T.J. and K.B. Lunde. 2005. Parasite infection and limb malformations: A growing problem in amphibian conservation, pp. 124–138. In: M.J. Lannoo (ed.), *Amphibian Declines: The Conservation Status of United States Species*. University of California Press, Berkeley, California, USA.

Johnson, P.T.J., K.B. Lunde, E.M. Thurman, E.G. Ritchie, S.N. Wray, D.R. Sutherland, J.M. Kapfer, T.J. Frest, J. Bowerman, and A.R. Blaustein. 2002. Parasite (*Ribeiroia ondatrae*) infection linked to amphibian malformations in the western United States. *Ecological Monographs* 72: 151–168. https://doi.org/10.2307/3100022.

Lannoo, M. 2008. *Malformed Frogs: The Collapse of Aquatic Ecosystems*. University of California Press, Berkeley, California, USA.

Mable, B.K. and L.A. Rye. 1992. Developmental abnormalities in triploid hybrids between tetraploid and diploid tree frogs (genus *Hyla*). *Canadian Journal of Zoology* 70: 2072–2076. https://doi.org/10.1139/z92-279.

Meteyer, C.U. 2000. Field Guide to Malformation of Frogs and Toads with Radiographic Interpretations. Biological Science Report USGS/BRD/BSR–2000–005, U.S. Geological Survey, U.S. Fish and Wildlife Service National Conservation Training Center, Shepherdstown, West Virginia, USA.

Narvaes, P. and M. Trefaut-Rodrigues. 2009. Taxonomic revision of *Rhinella granulosa* species group (Amphibia, Anura, Bufonidae), with a description of a new species. *Arquivos de Zoologia* 40: 1–73. http://dx.doi.org/10.11606/issn.2176-7793.v40i1p1-73.

Ovalle-Pacheco, A., C. Camacho-Rozo, and S. Arroyo. 2019. Amphibians from Serrania de Las Quinchas, in the mid-Magdalena river valley, Colombia. *Check List* 15: 387–404. https://doi.org/10.15560/15.3.387.

Ouellet, M., J. Bonin, J. Rodrigue, J.L. DesGranges, and S. Lair. 1997. Hind limb deformities (ectromelia, ectrodactyly) in free-living anurans from agricultural habitats. *Journal of Wildlife Diseases* 33: 95–104. http://dx.doi.org/10.7589/0090-3558-33.1.95.

Ramalho, W.P., F. Maffei, V. Guerra, D.P. Da Silva, L.R. De Matos, and L.J. Vieira. 2017. Anophthalmia in adults of two Amazonian treefrogs (Anura: Hylidae). *The Herpetological Bulletin* 139: 43–44.

Rajakaruna, R.S., M.J.R. Piyatissa, U.A. Jayawardena, A.N. Navaratne, and P.H. Amerasinghe. 2008. Trematode infection induced malformations in the common hourglass treefrogs. *Journal of Zoology* 275: 89–95. https://doi.org/10.1111/j.1469-7998.2008.00416.x.

Reeves, M.K., C.L. Dolph, H. Zimmer, R.S. Tjeerdema, and K.A. Trust. 2008. Road proximity increases risk of skeletal abnormalities in wood frogs from national wildlife refuges in Alaska. *Environmental Health Perspectives* 116: 1009–1014. https://doi.org/ 10.1289/ehp.10963.

Reeves, M.K., K.A. Medley, A.E. Pinkney, M. Holyoak, P.T.J. Johnson, and M.J. Lannoo. 2013. Localized hotspots drive continental geography of abnormal amphibians on U.S. wild-life refuges. *PLOS One* 8: 1–14. https://doi.org/10.1371/journal.pone.0077467.

Robles-Mendoza, C., C. García-Basilio, S. Cram-Heydrich, M. Hernández-Quiroz, and C. Vanegas-Pérez. 2009. Organophosphorus pesticides effect on early stages of the axolotl *Ambystoma mexicanum* (Amphibia: Caudata). *Chemosphere* 74: 703–710. https://doi.org/10.1016/j.chemosphere.2008.09.087.

Roy, D. 2002. Amphibians as environmental sentinels. *Journal of Bioscience* 27:187–188. https://doi.org/10.1007/BF02704906.

Ruiz-Carranza, P.M., M.C. Ardila-Robayo, and J.D. Lynch. 1996. Lista actualizada de la fauna amphibia de Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 20: 365–415.

Schoff, P.K., C.M. Johnson, A.M. Schotthoefer, J.E. Murphy, C. Lieske, R.A. Cole, L.B. Johnson, and V.R. Beasley. 2003. Prevalence of skeletal and eye malformations in frogs from north-central United States: estimations based on collections from randomly selected sites. *Journal of Wildlife Diseases* 39: 510–521. https://doi.org/10.7589/0090-3558-39.3.510.

Sierra-Serrano, O., J.D.J. Bolaño, J.A. Zúñiga-Baos, and H.D. Granda-Rodríguez. 2023. Anopthalmia in *Lithobates Vaillanti* (Brocchi 1877) (Anura: Ranidae) in Colombia. *Reptiles & Amphibians* 30: e20097. https://doi.org/10.17161/randa.v30i1.20097.

Soto-Rojas, C., I. Suazo-Ortuño, J.A. Montoya-Laos, and J. Alvaro-Díaz. 2017. Habitat quality affects the incidence of morphological abnormalities in the endangered salamander *Ambystoma ordinarium*. *PLOS One* 12: 1–15. https://doi.org/10.1371/journal.pone.0183573.

Souza, F.C., A.L.F. Silva, C.S. Anjos, T.F. Estevinho, M.O. Lisboa, and M. Menin. 2021. New records of morphological anomalies in anurans, with a review for Brazil. *Herpetology Notes* 14: 31–41.

Toledo, L.F. and R.S. Ribeiro. 2009. The Archipelago of Fernando de Noronha: an intriguing malformed toad hotspot in South America. *EcoHealth* 6: 351–357. https://doi.org/10.1007/s10393-010-0277-2.

Toledo, L.F., O.G.S. Araújo, L.D. Guimarães, R. Lingnau, and C.F.B. Haddad. 2007. Visual and acoustic signaling in three species of Brazilian nocturnal tree frogs (Anura, Hylidae). *Phyllomedusa* 6: 61–68. https://doi.org/10.11606/issn.2316-9079.v6i1p61-68.

Venerozo-Tlazalo, 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.

Williams, R.N., D.H. Bos, D. Gopurenko, and J.A. DeWoody. 2008. Amphibian malformations and inbreeding. *Biology Letters* 4: 549–552. https://doi.org/10.1098/ rsbl.2008.0233.