REPTILES & AMPHIBIANS

Black-eye Malformations in Two Herpetofaunal Species from the Central Region and Caribbean Coast of Costa Rica

Javier E. Cortés-Suárez[1], Christian G. Herrera-Martinez[2,3,4], and Álvaro A. Zamora-Roda[5]

[1]Municipio de Santa Sofía, Departamento de Boyacá, Colombia (javi1885@gmail.com)
[2]Asesoría en Gestión de la Biodiversidad (AGB), San José, Costa Rica
[3]Programa de Maestría en Manejo y Conservación de Bosques Tropicales y Biodiversidad, Escuela de Posgrado, CATIE, 30501, Turrialba, Cartago, Costa Rica
[4]Departamento de Ciencias Básicas, Universidad Latina, San José, Costa Rica
[5]Turrialba, Cartago, Costa Rica

Malformations are structural defects produced by a mutation, trauma, or errors that occur early in the developmental stages of an organism (Blaustein and Johnson 2003), although events that cause developmental errors are temporally distant from the malformations seen in fully developed animals (Meteyer 2000). Malformations in anurans have been reported since 1554 (Gesner 1554) for more than 400 species on all continents (Henle et al. 2017b), with a notable increase in the last few decades (Blaustein and Johnson 2003; Medina et al. 2013) and in various microhabitats (Piha et al. 2006; Medina et al. 2013). Abnormalities/malformations in reptiles are not uncommon (Garín-Barrio et al. 2011), and are most frequently observed in ophidians and chelonians, and less often in saurians (Rhodin et al. 1984; Martinez-Silvestre et al. 1997; Pritchard 2008; Bernhard et al. 2012; Pérez-Delgadillo et al. 2015).

Herpetofaunal abnormalities have been poorly studied in Costa Rica (Hedrick and Cossel 2014; Monge-Velázquez et al. 2016; Cortés-Suárez 2018a) and only one limb malformation in anurans has been documented (Hedrick and Cossel 2014; Monge-Velázquez et al. 2016). Eye malformations include microphthalmia, anophthalmia, and black eye (blackish iris) (Glaw and Vences 1997; Meteyer 2000; Cortés-Suárez 2018b), none of which had been documented in Costa Rican herpetofauna. Herein we report the first records of black eye (blackish iris) in the Spiny-headed Treefrog, *Triprion spinosus* (Steindachner 1864) (Anura: Hylidae), and the Mexican Snake Eater, *Clelia scytalina* (Cope 1867) (Squamata: Dipsadidae) in Costa Rica.

At 0321 h on 27 March 2020, we encountered and photographed an adult male Spiny-headed Treefrog (*Triprion spinosus*) in the Centro Turistico Manú, Jiménez, Limón

Fig. 1. An adult Spiny-headed Treefrog (*Triprion spinosus*) (left) and a subadult Mexican Snake Eater (*Clelia scytalina*) (right) with eye malformations (black eye/blackish iris). Photographs by Álvaro A. Zamora.

Reptiles & Amphibians ISSN 2332-4961

Fig. 2. An adult Spiny-headed Treefrog (*Triprion spinosus*) (left) and a Mexican Snake Eater (*Clelia scytalina*) (right) with blackish/brownish or darkish films that cause the eye to look dark without any effect on the iris (i.e., with the blackish iris eye malformation). Photographs by Christian G. Herrera and Álvaro A. Zamora.

Province, Costa Rica (10°09'30"N, 83°46'57"W; WGS 84; elev. 512 m asl) (Fig. 1). At 2030 h on 27 November 2020, we encountered and photographed a subadult female Mexican Snake Eater (*Clelia scytalina*) in the process of shedding in Santa Cruz, Cartago Province, Costa Rica (9°55'59.7"N, 83°46'39.3"W; WGS 84; elev. 1,750 m asl) (Fig. 1). We held the latter in captivity for several days until it finished shedding and the eye malformation was more clearly defined. Both the anuran and the snake had a black eye/blackish iris (Glaw and Vences 1997; Henle and Dubois 2017a), also known in the literature as an eye with no iris (Meteyer 2000); the right eye in the anuran and the left eye in the snake were affected.

Unilateral black-eye is a subcategory of heterochromia (Henle and Dubois 2017a), which is thought to be the result of a recessive mutation (e.g., Vershinin 2004). Eyes with a blackish iris have been recorded in several anuran families (Bufonidae, Ranidae, and Hylidae) (Glaw and Vences 1997). Other eye malformations, such as anophthalmia, are relatively common in anurans (Meteyer 2000) and have been reported also for other Neotropical hylids in nature (Ramalho et al. 2017; Cortés-Suárez 2018b). In reptiles, ocular malformations occur with some frequency in captive-bred animals, possibly due to inbreeding or environmental conditions (Millichamp 1991).

According to Dubois (1979) and Galan et al. (1990), anurans with black-irises kept in captivity are not more fragile or less healthy than those with normal eye coloration, suggesting that frogs with black-eye mutations can survive in wild populations under certain conditions. In fact, C.G. Herrera Martinez (pers. obs.) has observed other Spiny-headed Treefrogs in nearby populations with one or both eyes affected. In some species of dendrobatids and in the Pumpkin Toadlet (*Brachycephalus ephippium*), black eye is the normal phenotype (Glaw and Vences 1997). Although we lack sufficient information to suggest that this condition is normal in *T. spinosus*, it could represent "normal body coloration with black eyes," one of three types of axanthism in amphibians listed by Jablonski et al. (2014).

Although black-eye and blackish-iris malformations are assumed to be the same by some authors (Dubois 1979; Galan et al. 1990; Glaw and Vences 1997; Meteyer 2000; Vershinin 2004; Jablonski et al. 2014; Henle and Dubois 2017a), we have noticed that black eye is similar to a blackish/brownish or darkish film that causes the eye to look dark without any effect on the iris (i.e., it doesn't appear uniformly black) (Meteyer 2000) (Fig. 2).

Acknowledgements

We thank Marcelo Abad for his assistance in the field, and Kenneth Gutierrez, administrator of the Centro Turistico Manú, for allowing us access to the property and his hospitality during fieldwork.

Literature Cited

Bernhard, R.R., L.L. Bernhard, and R.C. Vogt. 2012. *Podocnemis erythrocephala* (Red-headed Amazon River Turtle). Kyphosis. *Herpetological Review* 43: 639.

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.

Cortés-Suárez, J.E. 2018a. Caso de anormalidad registrado para el sapo gigante *Rhinella horribilis* (Wiegmann, 1833) en el territorio indígena Ngäbe de Osa, Costa Rica. *AmbienTico* 267: 59–61.

Cortés-Suárez, J.E. 2018b. Anoftalmia en *Dendropsophus luddeckei* (Anura: Hylidae) en un agroecosistema pastoril de Villa de Leyva, Colombia. Anophthalmia in *Dendropsophus luddeckei* (Anura: Hylidae) in an agroecosystem in de Villa Leyva, Colombia. *Revista Latinoamericana de Herpetología* 1: 53–54.

Dubois, A. 1979. Anomalies and mutations in natural populations of the *Rana* "*esculenta*" complex (Amphibia, Anura). *Mitteilungen aus dem Zoologischen Museum in Berlin* 55: 59–87. https://doi.org/10.1002/MMNZ.4830550108.

Galan, P., M. Vences., F. Glaw., G. Fernandez Arias, and M. Garcia-Paris. 1990. Beobachtungen zur Biologie von *Alytes obstetricans* in Nordwestiberien. *Herpetofauna* 12: 17–24.

Garin-Barrio, I., I. Sanz-Azkue., A. Gosá, and A. Bandrés. 2011. Un caso de cifosis en "*Podarcis pityusensis*" (Boscá, 1883), lagartija introducida en el peñón de Gaztelugatxe (Bizkaia). *Munibe (Ciencias Naturales-Natur Zientziak)* 59:

103–109.

Gesner, C. 1554. *Historiæ Animalium. Liber II: De Quadrupedibus Oviparis*. Froshover, Zurich, Deutschland.

Glaw, F. and M. Vences. 1997. Anuran eye colouration: definitions, variation, taxonomic implications and possible functions, pp. 125–138. In: W. Böhme, W. Bischoff, and T. Ziegler (eds.), *Herpetologia Bonnensis*. Proceedings of the Eighth Ordinary General Meeting of the Societas Herpetologica Europaea, Bonn, Germany.

Hedrik, A.R. and J.O. Cossel, Jr. 2014. Limb malformations of the critically endangered stream-breeding frog *Isthmohyla rivularis* in the Monteverde Cloud Forest Preserve, Costa Rica. *Herpetological Review* 45: 5–8.

Henle, K., A. Dubois, and V. Vershinin. 2017a. Commented glossary, terminology and synonymies of anomalies in natural populations of amphibians. *Mertensiella* 25: 98–48.

Henle, K., A. Dubois, and V. Vershinin. 2017b. A review of anomalies in natural populations of amphibians and their potential causes. *Mertensiella* 25: 57–164.

Jablonski, D., A. Alena., P. Vlček, and D. Jandzik. 2014. Axanthism in amphibians: A review and the first record in the widespread toad of the *Bufotes viridis* complex (Amphibia: Bufonidae). *Belgian Journal of Zoology* 144: 93–101. https://doi.org/10.26496/bjz.2014.69.

Martínez-Silvestre, A., J. Soler., R. Solé, and X. Sampere. 1997. Polidactilia en *Testudo hermanni* y causas teratogénicas en reptiles. *Boletín de la Asociación Herpetológica Española* 8: 35–38.

Medina, R.G., M.L. Ponssa., C. Guerra, and E. Aráoz. 2013. Amphibian abnormalities: Historical records of a museum collection in Tucuman Province, Argentina. *Herpetological Journal* 23: 193–193.

Meteyer, C.U. 2000. Field Guide to Malformations of Frogs and Toads with Radiographic Interpretations. Biological Science Report USGS/BRD/BSR-2000-005. U.S. Geological Survey National Wildlife Health Center, Madison, Wisconsin, USA.

Millichamp, N.J. 1991. Exotic animal ophthalmology, pp. 680–705. In: K. Gelatt (ed.), *Veterinary Ophthamology*. 2nd ed. Lea & Febiger, Philadelphia, Pennsylvania, USA.

Monge-Velázquez, M., J. Barrantes-Madrigal, and R. Seisdedos-de-Vergara. 2016. First report of limb abnormalities in *Rhaebo haematiticus* (Anura: Bufonidae) at La Selva Biological Station, Sarapiquí, Costa Rica. *Alytes* 33: 16–20.

Pérez-Delgadillo, A.G., G.E. Quintero-Díaz., R.A. Carbajal-Márquez, and C.M. García-Balderas. 2015. Primer reporte de cifosis en *Sceloporus torquatus* (Squamata: Phrynosomatidae) en el estado de Aguascalientes, México. *Revista Mexicana de Biodiversidad* 86: 272–274. http://dx.doi.org/10.7550/rmb.43719.

Piha, J., M. Pekkonen, and J. Merilá. 2006. Morphological abnormalities in amphibians in agricultural habitats: A case study of the Common Frog *Rana temporaria*. *Copeia* 2006: 810–817. https://doi.org/10.1643/0045-8511(2006)6[810:MAIAIA]2.0.CO;2.

Pritchard, H.C. 2008. Evolution and structure of the turtle shell, pp. 70-72. In: J. Wyneke, M.H. Godfrey, and V. Bels (eds.), *Biology of Turtles*. CRC Press, Boca Raton, Florida, USA.

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

Rhodin, A.G., P.H. Pritchard, and R.A. Mittermeier. 1984. The incidence of spinal deformities in marine turtles, with notes on the prevalence of kyphosis in Indonesian *Chelonia mydas*. *British Journal of Herpetology* 6: 369–373.

Vershinin, V.L. 2004. Frequency of iris depigmentation in urban populations of *Rana arvalis* frogs. *Russian Journal of Ecology* 35: 58–62. https://doi.org/10.1023/B:RUSE.0000011112.17428.f5.