Ortiz, M.E., Fernández, M.J., Lizana, M. & Alarcos, G. 2006. Un caso de polimelia en *Lissotriton boscai* (Lataste, 1879). *Boletín de la Asociación Herpetológica Española*, 17(1): 42–43.

Ouellet, M., Bonin, J., Rodrigue, J., DesGranges, J.L. & Lair, S. 1997. Hindlimb deformities (Ectromelia, Ectrodactyly) in free-living anurans from agricultural habitats. *Journal of Wildlife Diseases*, 33: 95–104.

Pereira, R.J., Martínez-Solano, I., Buckley, D. 2016. Hybridization during altitudinal range shifts: nuclear introgression leads to extensive cyto-nuclear discordance in the fire salamander. *Molecular Ecology*, 25(7): 1551-1565.

Poch, S. & Carné, A. 2021. Report of polymelia in *Lissotriton helveticus. Boletín de la Asociación Herpetológica Española*, 32: 54–56.

Sequeira, F., Gonçalves, H., Meneses, C. & Mouta-Faria, M. 1999. Morphological abnormalities in a population of *Chioglossa lusitanica. Boletín de la Asociación Herpetológica Española*, 10: 35–36.

Stopper, G.F., Hecker, L., Franssen, R.A. & Sessions, S.K. 2002. How trematodes cause limb deformities in amphibians. *Journal of Experimental Zoology*, 294: 252–263.

Taylor, B., Skelly, D., Demarchis, L.K., Slade, M.D., Galusha, D. & Rabinowitz, P.M. 2005. Proximity to pollution sources and risk of amphibian limb malformation. *Environmental Health Perspectives*, 113(11): 1497–1501.

Velo-Antón, G., Buckley, D. 2015. Salamandra común – *Salamandra salamandra. In*: Salvador, A. & Martínez-Solano, I. (eds.). *Enciclopedia Virtual de los Vertebrados Españoles*. Museo Nacional de Ciencias Naturales - CSIC. Madrid.

Velo-Antón, G., Alvarez, D., & Alarcón-Ríos, L. 2021. Monsters in the city: multiple deformities increase in terrestrial-breeding urban salamanders. *Amphibia-Reptilia*, 42(3), 391–398.

Villanueva, A. 2007. Polimelia en un ejemplar de *Salamandra salamandra* en Asturias. *Boletín de la Asociación Herpetológica Española*, 18: 90–91.

Zamora-Camacho, F.J. 2016. Anomalías múltiples en diversas extremidades en *Pleurodeles waltl. Boletín de la Asociación Herpetológica Española*, 27: 22–24.

Zamora-Camacho, F.J., Medina-Gálvez, L. 2019. Anomalías en las extremidades de varios ejemplares de *Triturus pygmaeus* de una misma charca. *Boletín de la Asociación Herpetológica Española*, 30: 62–63.

First report of polymelia in *Epidalea calamita*

Helena Martínez-Gil[1,*] & Iñigo Martínez-Solano[2]

[1] Departament de Biologia Evolutiva, Ecologia i Ciencies ambientals. Universitat de Barcelona. 08028 Barcelona. Spain. C.e.: helenamartg95@gmail.com

[2] Departamento de Biodiversidad y Biología Evolutiva. Museo Nacional de Ciencias Naturales-CSIC. Cl. José Gutiérrez Abascal, 2. 28006 Madrid. Spain.

Fecha de aceptación: 18 de abril de 2024.

Key words: malformation, limb anormalities, amphibians, natterjack toad.

Resumen: En abril de 2022 se encontró una hembra de sapo corredor (*Epidalea calamita*) con polimelia en la Sierra de Guadarrama (Comunidad de Madrid, España), durante un muestreo diurno. La malformación consistía en la presencia de una extremidad adicional, aparentemente osificada pero no funcional, en posición ventral. Esta observación constituye el primer caso de polimelia documentado en la especie.

Amphibians are the most threatened group of vertebrates, with many species showing negative trends at the global scale (Wake & Koo, 2018). Concern about the health of amphibian populations has promoted studies focusing on potential stressors, with morphological malformations emerging as a significant threat due to their potential ecological and demographic consequences. These deformities directly affect individual fitness (Møller, 1997; Mira-Jover *et al.*, in press), increasing predation risk and mortality, which may eventually have an impact on population dynamics. Morphological malformations usually occur with a basal prevalence rate around 2-5% in natural amphibian populations (Johnson *et al.*, 2010), but when their incidence exceeds this threshold they can become a potential risk for popula-

Figure 1: Adult female *Epidalea calamita* with an extra hind limb in the lower central part of the abdomen. a) Dorsal and b) ventral view.
Figura 1: Hembra adulta de *Epidalea calamita* con una extremidad posterior extra en la parte baja del abdomen. Vistas a) dorsal y b) ventral.

tion viability. One noteworthy malformation is polymelia, the occurrence of extra limbs (Meteyer, 2000), which together with polydactyly (the presence of extra fingers), represent the most frequently reported malformations in amphibians worldwide (Blaustein & Johnson, 2003). In the Iberian Peninsula, there has been a recent increase in reports of morphological deformities in amphibians, including among others polymelia and polydactyly (Galán, 2011; Martínez-Silvestre *et al.*, 2014; Zamora-Camacho, 2016; Laurentino *et al.*, 2016; Espasandín, 2018; Poch & Carné, 2021).

Here we describe a case of polymelia in an adult female natterjack toad, *Epidalea calamita* (Laurenti, 1768), observed during a diurnal field survey on April 7th, 2022. The individual was found near an ephemeral pond in puerto de Canencia (Sierra de Guadarrama, Madrid: 40º52'18.5"N / 3º45'22.8"W) and exhibited an extra limb located in the lower-central part of the abdomen (Figure 1). The extra limb was apparently ossified but less robust, thinner and shorter than the typical hind limbs, and presented four small toes. The hind limbs were normal in appearance and function, whereas the extra limb was non-functional, lacking mobility and not contributing to locomotion. Morphological malformations are usually associated with lower survival rates; however, based on its size (> 5 cm) this individual had successfully reached sexual maturity. Similar malformations have been previously documented in several urodele (Martínez-Silvestre *et al.*, 2014; Zamora-Camacho, 2016; Duque-Amado *et al.*, 2020; Poch & Carné, 2021) and anuran species (Barragán-Ramírez & Navarrete-Heredia, 2011; Oser *et al.*, 2023), but to the best of our knowledge this observation represents the first record of polymelia in *E. calamita*.

Several factors have been associated with the development of morphological deformities, including genetic mutations, environmental factors like UV radiation and extreme temperatures, or chemical pollutants (Ankley *et al.*, 2002; Blaustein & Johnson, 2003; Ankley *et al.*, 2004; Velo-Antón *et al.*, 2011). Parasite infections,

specifically the trematode *Ribeiroia* spp., have also been associated with limb malformations (including extra limbs and missing hindlimbs) in several anuran populations in North America (Johnson *et al.*, 2002). These factors may act independently or synergically, triggering developmental responses causing malformations. In our particular case, we can only speculate about the underlying causes of this phenomenon and its prevalence at the population level, since we did not perform detailed studies using CT-SCAN or other methods and the area was sampled only once. The site where the observation was recorded comprises montane meadows (1524 masl) where UV radiation could represent a stressing factor, and is surrounded by managed pine plantations possibly treated with pesticides. Further studies should assess the frequency of morphological deformities in the populations of *E. calamita* and other syntopic amphibian species, and conduct physicochemical and parasitological surveys to assess the possible roles of these factors in their dynamics.

References

Ankley, G.T., Diamante, S.A., Tietge, J.E., Holcombe, G.W., Jensen, K.M., Defoe, D.L. & Peterson, R. 2002. Assessment of the risk of solar ultraviolet radiation to amphibians. I. Dose-dependent induction of hindlimb malformations in the northern leopard frog (*Rana pipiens*). *Environmental Science & Technology*, 36: 2853–2858.

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

Barragán-Ramírez, J.L. & Navarrete-Heredia, J.L. 2011. Primer registro de un caso de malformaciones en *Lithobates neovolcanicus* (Hillis & Frost 1985) (Anura: Ranidae). *Acta Zoológica Mexicana*, 27: 837–841.

Blaustein, A.R. & Johnson, P.T. 2003. The complexity of deformed amphibians. *Frontiers in Ecology and the Environment*, 1: 87–94.

Duque-Amado, C., Calvo Revuelta, M. & Sánchez-Vialas, A. 2020. Polimelia en un ejemplar de *Paramesotriton hongkongensis* (Caudata: Salamandridae) de la colección de herpetología del Museo Nacional de Ciencias Naturales de Madrid. *Boletín de la Asociación Herpetológica Española*, 31: 36–39.

Espasandín, I. 2018. Recopilación de nuevos casos de malformaciones en diferentes individuos de *Alytes obstetricans* en una población de A Coruña, Galicia. *Boletín de la Asociación Herpetológica Española*, 29: 66–69.

Galán, P. 2011. Anfibios con malformaciones en el Parque Natural das Fragas do Eume (A Coruña, Galicia). *Boletín de la Asociación Herpetológica Española*, 22: 65–67.

Johnson, P.T.J., Lunde, K.B., Thurman, E.M., Ritchie, E.G., Wray, S.N., Sutherland, D.R., *et al.* 2002. Parasite (*Ribeiroia ondatrae*) infection linked to amphibian malformations in the western United States. *Ecological Monographs*, 72: 151–168.

Johnson, P.T.J., Reeves, M.K., Krest, S.K. & Pinkney, A.E. 2010. A decade of deformities: advances in our understanding of amphibian malformations and their implications. *In*: Sparling, D.W., Linder, G., Bishop, C.A., Krest, S.K. *et al.* (eds.). *Ecotoxicology of Amphibians and Reptiles*. 2nd Edition. Boca Raton (CRC Press). USA.

Laurentino, T.G., Pais, M.P. & Rosa, G.M. 2016. From a local observation to a European-wide phenomenon: Amphibian deformities at Serra da Estrela Natural Park, Portugal. *Basic and Applied Herpetology*, 30: 7–23.

Martínez-Silvestre, A., Amat, F. & Carranza, S. 2014. Natural incidence of body abnormalities in the Montseny newt, *Calotriton arnoldi* Carranza and Amat, 2005. *Herpetology Notes*, 7: 277–279.

Meteyer, C.U. 2000. Field guide to malformations of frogs and toads: with radiographic interpretations (No. 2000-0005). U.S. *Geological Survey Biological Science Report* USGS/BRD/BSR-2000-0005.

Mira-Jover, A., Rodríguez-Caro, R.C., Noguera, J.C., Fritz, U., Kehlmaier, C., García de la Fuente, M.I., *et al.* (in press). Shorter telomeres are associated with shell anomalies in a long-lived tortoise. *Journal of Zoology*, 323(1): 67–75.

Møller, A.P. 1997. Developmental stability and fitness: a review. *The American Naturalist*, 149(5), 916–932.

Oser, F., Sansiñena, J.A., Alcalde, L. & Natale, G.S. 2023. Análisis morfológico de un caso de polimelia en *Rhinella dorbignyi* (Anura: Bufonidae). *Cuadernos de Herpetología*, 37: 213–218.

Poch, S. & Carné, A. 2021. Report of polymelia in *Lissotriton helveticus*. *Boletín de la Asociación Herpetológica Española*, 32: 54–56.

Velo-Antón, G., Becker, C.G. & Cordero-Rivera, A. 2011. Turtle carapace anomalies: the roles of genetic diversity and environment. *PLoS ONE*, 6: e18714.

Wake, D.B. & Koo, M.S. 2018. Amphibians. *Current Biology*, 28: R1237–R1241.

Zamora-Camacho, F.J. 2016. Anomalías múltiples en diversas extremidades en *Pleurodeles waltl*. *Revista Española de Herpetología*, 1: 209–271.