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SHORT COMMUNICATION

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Ocular anomalies in four species of European toad

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Physical anomalies in frogs and toads (anurans) were first described in a scientific manner in the year 1554 (Mônico et al., 2019). However, with intensification of human impact, anomalies have become ever more common (Garcia-Muñoz et al., 2010; Johnson et al., 2010). Moreover such anomalies are associated with population declines (Cohen, 2001).

Vision is crucial to the fitness and survival of adult anurans (Ingle, 1976). Nevertheless when ocular deformities, such as microphthalmia (an unusually small eye), anophthalmia (absence of an eye), dyscoria (abnormally shaped pupil) or corectopia (abnormally placed pupil), are unilateral, fitness may be relatively unaffected. Data compiled by Henle et al. (2017) shows that anophthalmia and microphthalmia taken together constitute more than one fourth of non-skeletal morphological anomalies in anurans. The prevalence of anophthalmia has been recorded as 0.036 % in a healthy population of *Bufo bufo* (Wolf, 1994) while in two populations of *Lithobates sylvaticus*, in which 7260 and 5243 individuals were examined, the prevalence was somewhat greater, at 0.07 % and 0.15 % respectively (Eaton et al., 2004). It would appear that microphthalmia is several times less common than anophthalmia (Henle et al., 2017).

Causes of deformities can be environmental and/or genetic. The environmental causal factors are teratogens, irradiation (e.g. Nishioka et al., 1981), pathogens, physical injury, egg retention time, temperature (Briggs, 1941; Witschi, 1952; Mikamo & Hamaguchi, 1975) and the effects of predators (Caldwell, 1982) or disease (Bradford, 1991). The genetic causal factors are hybridisation (Delarue, 1982) or inbreeding (Humphrey, 1948). Some cases of anophthalmia are related to thyroid carcinoma (Cheong et al., 2000). Dyscoria and corectopia in amphibians have so far not received much attention, which suggests that they are either rare, overlooked, or both. Colour aberrations and other anomalies of amphibians in Poland are known to include eye depigmentation, partial eye depigmentation, and black eye (Kolenda et al., 2017). Here I describe cases of ocular anomalies in three anuran species from western Poland (Gorzów Wielkopolski) and in one species from Croatia.

On 1st June 2011 at 17:51 h an adult *Bufo bufo* was rescued from a gully pot in Poland (52° 45’15” N, 15° 13’28” E). The individual had unilateral microphthalmia (Fig. 1). Its behaviour was normal and it had no other anomalies.

On the 8th October 2011 at 22:12 h an adult *Bombina bombina* was rescued from another nearby gully pot in Poland (52° 45’16” N, 15° 13’19” E). It showed unilareral anophthalmia (Fig. 2). Nevertheless it was lively and seemed healthy. Several other normal conspecifics were seen in the area.

Figure 1. *Bufo bufo* with unilateral microphthalmia in Poland

Figure 2. *Bombina bombina* with unilateral anophthalmia in Poland

On the 13th April 2012 at 14:52 h in a garden in Poland (52° 45’55” N, 15° 14’24” E) a pair of *B. bufo* in amplexus was seen migrating to a breeding pond. The female had unilateral microphthalmia (Fig. 3). The individual was in good condition and had no other anomaly. Many other conspecifics, both juvenile and adult, have been observed for years in this specific location but the individual with the anomaly was not seen again and neither were any other malformed *B. bufo*.

On 11th June 2013 at 22:55 h in a garden in Poland (52°

Figure 3. A female of *Bufo bufo* with unilateral microphthalmia in amplexus in Poland

Figure 5. *Bombina variegata* with unilateral anophthalmia in Croatia

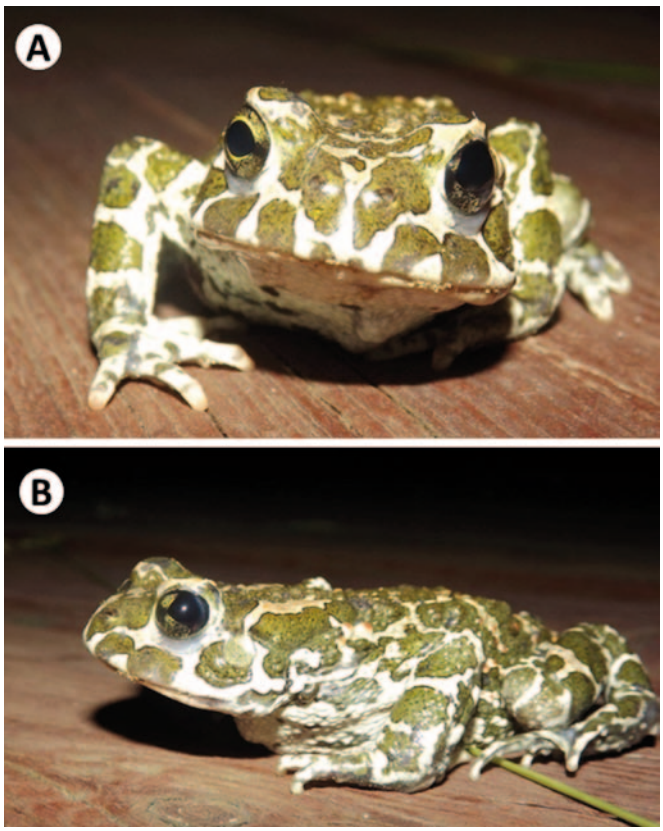

Figure 4. An adult *Bufotes viridis* with unilateral corectopia and dyscoria in Poland – A. Frontal view, B. lateral view

45'55" N, 15° 14'24" E) a single adult individual of *Bufotes viridis* was observed with corectopia and dyscoria (Fig. 4A & B). The skin around the eye had some grey discoloration. To my knowledge this is the first case of corectopia and dyscoria in the family Bufonidae. The individual was not observed again despite searches.

Finally, on 26th July 2012 at 08:12 h one individual of *Bombina variegata* with unilateral anophthalmia was found in a puddle in a dried stream bed in Medveja, Istra, Croatia (45° 16'16" N, 14° 15'09" E) (Fig. 5). In that habitat it was syntopic with many conspecifics, *Natrix natrix* and *Salamandra salamandra* larvae. Probably the same individual was also seen the next day at 10:58 h. It seemed not to have other problems but it was smaller than conspecifics, probably because of difficulties in hunting caused by the malformation. There was no injury or scar visible, suggesting that the individual had either not developed the eye at all or that a trauma happened in an early larval developmental stage.

All but one observation were made in urban or suburban areas so it is possible that these malformations are of indirect anthropogenic origin - for example pollution in an early developmental stage (Fort, 2006) or irradiation (Henle et al., 2017). Amphibians are good bioindicators since they are sensitive to water pollution because their early development occurs in the aquatic environment (Duellman & Trueb, 1986; Dunson et al., 1992; Blaustein et al., 1994). In turn, the aquatic environment easily becomes polluted as water drains from the land. Future exotoxicological, developmental, epidemiological and genetic studies are needed to explain the interactions of factors leading to ocular deformities. Furthermore, the significance of such anomalies in amphibian declines and the role of anthropopressure on the frequency of such anomalies need to be explained.

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