

First record of cannibalism and possible toe-luring in *Bufoates boulengeri*

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RESUMEN: Se describe el primer caso conocido de canibalismo en el sapo verde norteafricano *Bufoates boulengeri*, por parte de un adulto sobre tres individuos post-metamórficos atrapados en el interior de un aljibe seco del sur de Marruecos. Asimismo, se cita la contracción estereotipada del dedo medio del pie como posible señuelo, descrita previamente en otro bufónido: el sapo de caña *Rhinella marina*.

Cannibalism amongst anurans is a well-known phenomenon across different ontogenetic stages: on eggs, tadpoles and post-metamorphic specimens (Crump, 1983; Petranka & Thomas, 1995; Pirani *et al.*, 2010; Sousa *et al.*, 2016), although it is mainly considered an opportunistic form of predation (Duellman & Trueb, 1994). From an evolutionary point of view, it could seem disadvantageous to eat a close relative. Nevertheless, Eickwort (1973) showed mathematically that only a very small increase in individual fitness of the cannibal would be required to maintain this behaviour, even if full siblings are eaten (Crump, 1983).

We report here the first record of cannibalism in the African green toad *Bufoates boulengeri* (Latasa, 1879), previously considered the European green toad *Bufoates viridis* (Laurenti, 1768) (Jiménez-Robles & Martínez del Marmol Marín, 2013) but currently deemed a species within the radiation of the genus *Bufoates* (see Dufresnes *et al.*, 2019). Cannibalistic behaviours have been reported in *B. viridis* in different scenarios: adult/juvenile, tadpole/tadpole or tadpole/eggs (Kovács & Sas, 2009; Vlček *et al.*, 2013). The same holds true for other Bufonidae species such as the cane toad *Rhinella marina* (Linnaeus, 1758) (Pizzatto & Shine, 2008).



Figure 1: a) A subtle movement of the post-metamorphic toad in the right, b) triggers the attack of the adult conspecific. Following, c) the prey is grasped and d) swallowed.

Figura 1: a) Un leve movimiento del sapo post-metamórfico en la derecha, b) desencadena el ataque del adulto coespecífico. A continuación, c) agarra la presa y d) se la traga.

An adult male *B. boulengeri* was seen predating on three post-metamorphic conspecifics while we were rescuing trapped animals from a dry water cistern in August 2019 near Tan-Tan, Morocco ($28^{\circ}31'03.3''N / 11^{\circ}08'40.4''W$, 166 masl). We noticed the abnormal behaviour just before releasing them back into the wild. The increasing number of these wells and cisterns, which often attract desert vertebrates and act as death traps, is known to have a substantial impact upon amphibian populations (García-Cardenete *et al.*, 2014). *Bufo boulengeri* uses a wide range of permanent and ephemeral habitats, including these cisterns and concrete reservoirs, amongst other human-altered water sources (Bons & Geniez, 1996; Sicilia *et al.*, 2009). Consequently, it is the most common amphibian species found in this type of buildings (García-Cardenete *et al.*, 2014).

Although *B. boulengeri* mainly feeds on invertebrates (Schlein *et al.*, 2004), for large enough accidentally-captive specimens, post-metamorphic conspecifics might turn out to be a feasible food resource to avoid starvation. According to Pizzatto & Shine (2008), since toads are a poor-quality prey, switching from insectivory to cannibalism might be favoured

by the high densities of small conspecifics and the scarcity of alternatives. Both circumstances occur inside drying water cisterns, and very likely, around the natural ephemeral water points where that species often breeds.

As Pizzatto & Shine (2008) pointed out in *R. marina*, predation was elicited by the prey movements (Figure 1). Furthermore, *B. boulengeri* performed a toe-twitching display, which lasted 9 seconds and consisted in simultaneously flexing the long middle toe from both hind feet, after targeting a post-metamorphic. This kind of movements have been described in at least 38 amphibian species (Erdmann, 2017), and they seem to aim at agitating prey into continued movement: this makes the prey easier to detect since amphibians use visual cues (Sloggett & Zeilstra, 2008). This toe-twitching could have ended up as a visual luring beyond the original vibrational stimulus in the particular case of the also cannibalistic *R. marina*, which displays it in order to attract smaller conspecifics (Hagman & Shine, 2008; Sloggett & Zeilstra, 2008). Thus, the pedal movements of *B. boulengeri* might be another instance of actual toe-luring derived from toe-twitching.

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Tail bifurcation recorded in *Chioglossa lusitanica*

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RESUMEN: La cola bifida es una malformación que se ha registrado en diversas especies de anfibios en todo el mundo, estando asociada en numerosas ocasiones a una hiperregeneración desencadenada por un daño mecánico. En esta nota presentamos un nuevo caso de cola bifurcada para el salamánrido ibérico *Chioglossa lusitanica*.

The golden-striped salamander (*Chioglossa lusitanica*) is an endemic species found in the northwestern corner of the Iberian Peninsula. This streamside salamander is able to drop its tail as anti-predatory behaviour, a mechanism called caudal autotomy (Arntzen, 1999; García-París *et al.*, 2004; Vences, 2014).

Chioglossa lusitanica is the only Iberian urodele that has this ability and subsequently is able to regenerate the tail (Vences, 1990, 2014; Arntzen, 1999). The importance of the tail in this species is very remarkable, having functional importance in locomotion, respiration, energy storage and behaviour (Wake & Dresner, 1967).

Occasionally after mechanical damage, generally caused by an attempted predation, the tail may undergo a bifurcation process. This is the most common cause of the appearance of bifid-tail animals (Dawson, 1932; Lynn, 1950). In European urodeles, tail bifurcation has been reported in *Calotriton arnoldi* (Martínez-Silvestre *et al.*, 2014), *Ichthyosaura alpestris* (Hachtel, 2011), *Lissotriton helveticus* (Giltay, 1932; Gosá, 2018), *Lissotriton montandoni* (Smirnov, 2014), *Salamandrina perspicillata* (Romano *et al.*, 2017), *Triturus carnifex* (Brandt, 1933; Henle *et al.*, 2012), *T. cristatus* (Bruch, 1864) and *T. dobrogicus* (Henle *et al.*, 2012). In the case of *C. lusitanica*, Sequeira *et al.* (1999) have