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NATURAL HISTORY NOTE

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Deadly snack: mortality of a European grass snake *Natrix natrix* while attempting to feed on a three-spined stickleback *Gasterosteus aculeatus*

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The European grass snake *Natrix natrix* is widespread throughout Eurasia inhabiting a variety of terrestrial and aquatic habitats. In Germany there are three natricine snake species, *N. natrix*, *Natrix helvetica*, and *Natrix tessellata*, the latter being more aquatic, preferring the benthic regions of lotic systems, and feeding almost exclusively on fish (Hutinec & Mebert, 2011; Weiperth et al., 2014). In contrast, *N. natrix* and the closely related *N. helvetica* mostly feed on amphibians (Reading & Davies 1996; Filippi et al., 1996; Luiselli et al., 2005), even when fish are readily available (Filippi & Luiselli, 2002), and when it comes to aquatic habitats they prefer lentic systems and are mostly observed on the surface (Hutinec & Mebert, 2011). At different life stages and body sizes, grass snake diets shift from feeding on tadpoles, recent metamorphs, and adult toads, frogs, and newts (Reading & Davies, 1996; Filippi et al., 1996; Luiselli et al., 1997; Gregory & Isaac, 2004). Other than amphibians, less frequently they also feed on small mammals, birds, other reptiles, fish, and snails (Gregory & Isaac, 2004; Luiselli et al., 2005; Consul et al., 2009; Hutinec & Mebert, 2011; Šukalo et al., 2014; Lunghi et al., 2018).

Reptile prey recognition and predatory behaviour have long been accepted as being innate behaviours, particularly in snakes. Prey is detected mainly by olfaction although visual cues, especially prey movement, are often very important and some prey preference may be influenced by experience (Burghardt et al., 1973; Stimac et al., 1982; Hailey & Davies, 1986). However, all these possibilities seem to be very variable even within the same family, so how much is innate and how much is learned behaviour may depend on the species (Burghardt, 1993). For example, Burghardt (1993) points out that some *Thamnophis* species are more visual and specialist than others of the same genus; Hailey & Davies (1986) point out that *Natrix maura* attacks in response to visual and tactile cues. However, when it comes to *N. natrix*, many of the feeding ecology studies and observations come from terrarium conditions or small studies from a few specific locations within this species' wide distribution (Reading & Davies, 1996; Luiselli et al., 1997; Gregory & Isaac, 2004; Luiselli et al., 2005; Hutinec & Mebert, 2011).

On 20 June 2021 at approximately 12:00 h we made what we believe is the first record of a European grass snake attempting to eat a three-spined stickleback *Gasterosteus aculeatus*. A dead subadult *N. natrix* (SVL 46.6 cm, TL 59.1 cm) was found with a three-spined stickleback (TL ~ 4 cm) lodged in the snake's mouth (Fig. 1). The snake was in the shallow waters on the north-eastern shores of Lake Constance, Germany (~399 m a.s.l.; the location is private property). Both creatures were already dead; we cannot estimate for how long, but the stickleback appeared to have been dead longer than the grass snake, most likely the stickleback asphyxiated and died before the snake. Possibly, but we believe unlikely, this might have been a case of

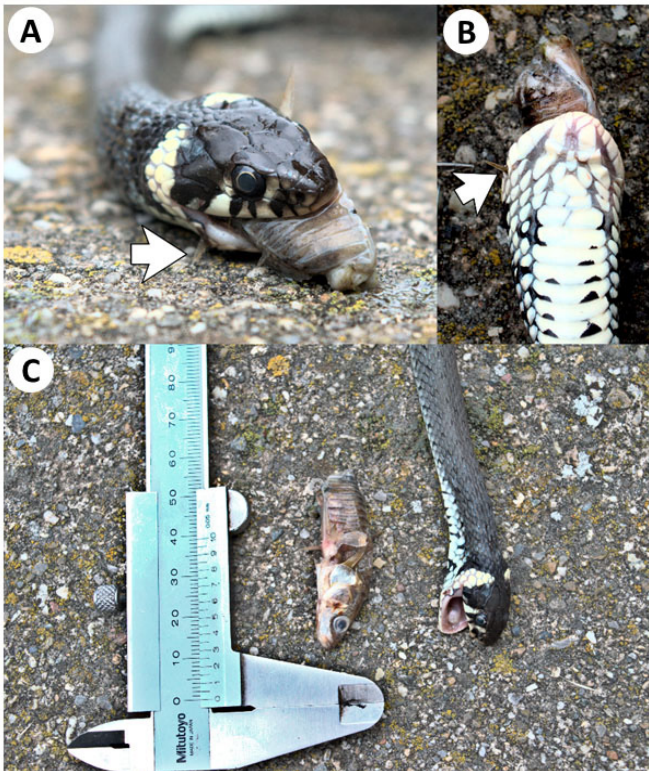

Figure 1. A sub-adult *Natrix natrix* with a *Gasterosteus aculeatus* lodged in its mouth - **A.** & **B.** The first dorsal spine of the stickleback has punctured the infralabial scales of the snake (white arrows), **C.** Both individuals after the authors separated them with a Vernier to give scale; note the stickleback appears as if it had probably died before the snake

carrion feeding. The snake had grasped the stickleback head-first, a behaviour that has been reported on other fish-eating natricines (Hailey & Davies, 1986) and it is also how grass snakes tend to ingest amphibians (Filippi et al., 1996). It is assumed that the stickleback's spines were erected when trying to defend itself and that is when the first dorsal spine punctured the snake's infralabial scales (Figs. 1 A & B) during attempted ingestion. The pelvic spines were locked in place: the left one already inside the snake's mouth and the right one outside, pressing against the corner of the mouth of the snake. All of this caused the fish to get stuck and the snake was not able to manipulate the prey any further nor set it free, leading to their demise. We cannot know whether the snake died close to where it had been hunting or whether it had been washed up from elsewhere.

Throughout the reviewed literature, both Tuniyev et al., (2011) and Weiperth et al., (2014) referred to Khonjakina (1969) (a source we have been unable to verify) as apparently the only other report of a natricine snake (*N. tessellata*) preying on a *Gasterosteus* - but we do not know the outcome from that interaction.

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