Herpetology Notes, Volume 18: 813–815 (published online on 17 August 2025)

How the tables may turn: opportunistic scavenging by tadpoles of *Discoglossus galganoi* Capula et al., 1985 and *Epidalea calamita* (Laurenti, 1768) on the carcass of a Viperine Watersnake, *Natrix maura* (Linnaeus, 1758) in northern Portugal

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In their larval stages, anurans are generally characterised by trophic flexibility that allows them to exploit a variety of food resources within aquatic ecosystems (Altig et al., 2007). Anuran tadpoles of most species are largely recognised detritivores, feeding primarily on algae and degraded plant materials (Altig et al., 2007). Although they are considered omnivorous, carnivory and cannibalism are well documented in some species, but scavenging events are still considered rare and underreported (Schiesari et al., 2009). Previous studies have described facultative scavenging by pond-dwelling tadpoles, but there is still insufficient knowledge for many species (e.g., Crump, 1992; Santos and Crottini, 2021).

The Mindelo Ornithological Reserve, located in northwestern Portugal, is considered a micro-hotspot for amphibian diversity in the country (Velo-Antón, 2020). This protected area sustains several temporary ponds across different microhabitats. After the winter rains, potholes on the main road of the reserve are transformed into puddles, small ephemeral ponds that tend to dry rapidly (Fig. 1A). Due to high sun exposure, lack of vegetation, and few predators, these ponds are excellent breeding sites for many of the amphibian species of the reserve (Velo-Antón, 2020).

In the early afternoon of 5 April 2025, we passed by one such puddle (41.3256°N, 8.7338°W) characterised by transparent water and a surface area of approximately 2 m^2, with estimated maximum depth of 10 cm. In it, we observed about 200 tadpoles of Iberian Painted Frog (*Discoglossus galganoi*) and about 50 of the Natterjack Toad (*Epidalea calamita*). Species were identified using morphological characteristics and known breeding locations. *Discoglossus galganoi* tadpoles were distinguished by their long, narrow tails and brownish coloration, while *E. calamita* tadpoles were recognised by their small size and blackish coloration when compared to other species in the region (Ferrand de Almeida et al., 2001). We ruled out that these tadpoles could be of the Spiny Toad, *Bufo spinosus* Daudin, 1803, since this species has not been reported to breed at this location and tends to avoid temporary ponds, preferring habitats with running and permanent water (Ortiz Santaliestra, 2014). At 16:55 h we returned to the same puddle and found a Viperine Watersnake (*Natrix maura*) that had died there since we first passed by and was partially submerged. While the exact cause of death remains unknown, the snake had possibly been hunted and killed or run over accidentally by a bicycle, both common threats in the area (Velo-Antón, 2020). We observed that the tadpoles of both species present in the puddle appeared to be feeding on the snake carcass (Fig. 1B, C) and on snake tissues dissociated from the body (Fig. 1D). While it is difficult to confirm whether the tadpoles were genuinely feeding on animal tissue or merely grazing on biofilm, organic debris, or microbial layers often present on submerged carcasses, our 2-h observation of the activity strongly suggests tissue consumption.

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Figure 1. (A) Ephemeral pond in the Mindelo Ornithological Reserve, northern Portugal, where the scavenging behaviour was observed. (B) Iberian Painted Frog (*Discoglossus galganoi*) and Natterjack Toad (*Epidalea calamita*) tadpoles feeding on a carcass of *Natrix maura*. The toad tadpoles are small and black. (C) Detail of a *D. galganoi* tadpole feeding on the tail of *N. maura*. (D) Both types of tadpoles feeding on *N. maura* tissue dissociated from the body. Photos by Marisa Naia.

We returned to the site two days later, when only 5–10 tadpoles of *D. galganoi* and no tadpoles of *E. calamita* remained. These tadpoles were still feeding on the carcass.

To our knowledge, this is the first report of opportunistic scavenging by these two species on a snake. A previous observation in the same area suggested that *D. galganoi* tadpoles seem to be efficient on feeding upon highly nutritious food resources, even when other food sources are present (Santos and Crottini, 2021). The observation provided here appears to confirm that both *D. galganoi* and *E. calamita* larvae can readily exploit protein resources when available, especially in nutrient-limited environments such as ephemeral ponds.

Decomposing animal matter is rich in protein and other nutrients that may accelerate growth (Altig et al., 2007), which can be critical in ephemeral ponds where the risk of desiccation is high. Tadpoles in these habitats often face intense competition for limited resources, and facultative scavenging may offer a powerful adaptive advantage. Previous studies have highlighted that amphibians might shift their feeding strategy when food availability is scarce and unpredictable (Petranka and Kennedy, 1999; Daftsios et al., 2024). This behaviour highlights the plasticity and opportunistic nature of the diet of *D. galganoi* and *E. calamita* tadpoles under certain conditions. Additionally, tadpole scavenging can influence nutrient cycling within temporary aquatic ecosystems, facilitating the breakdown of

animal biomass and contributing to detrital food webs (Beasley et al., 2019). However, scavenging behaviour can also increase the transmission of diseases, such as chytridiomycosis and ranavirosis, some of the main causes of amphibian declines (Altig et al., 2007; Le Sage et al., 2019). In addition, feeding on infected carcasses can spread zoospores and virulent tissues throughout the pond, increasing the rates of contact with pathogens, promoting disease transmission (Le Sage et al., 2019).

Scavenging behaviour in these tadpoles may be more prevalent than reported and perhaps remains largely unnoticed due to the readiness of tadpoles in consuming these food sources. Additional reports on scavenger-carrion relationships are needed to expand our understanding of the dietary ecology, trophic interactions and community dynamics of anuran larvae.

Acknowledgements. This work was supported by Fundação para a Ciência e Tecnologia (FCT) through the individual research grant (2023.02820.BD, DOI identifier https://doi.org/10.54499/2023.02820.BD) to MN. FCT also supported research contract 2023.08548.CEECIND to AC.

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Accepted by Dikansh Parmar