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Feeding on different life stages of the Common Spadefoot Toad, *Pelobates fuscus* (Laurenti, 1768), by the Medicinal Leech, *Hirudo medicinalis*

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Aquatic systems in Europe harbour different species of leeches and amphibians, consequently resulting in a wide array of possible interactions (Merilä and Sterner, 2002; Sket and Trontelj, 2008). These interactions vary in their impact on amphibians; leeches may use amphibians only as a means of transport (e.g., Stark et al., 2017; Starzecka et al., 2020), but parasitism and even predation occur as well (e.g., Merilä and Sterner, 2002; Lunghi et al., 2018; Seilern-Macpherson et al., 2024). One species that parasitises and preys on amphibians is the medicinal leech, *Hirudo medicinalis*. This species primarily parasitises large vertebrates, such as mammals and birds, but amphibians can form a major dietary component (Wilkin and Scofield, 1990). *Hirudo medicinalis* is known to parasitise or prey on Smooth Newts, *Lissotriton vulgaris* (Linnaeus, 1758), Common Toads, *Bufo bufo* (Linnaeus, 1758), Marsh Frogs, *Pelophylax ridibundus* (Pallas, 1771), Moor Frogs, *Rana arvalis* Nilsson, 1842, and Great Crested Newts, *Triturus cristatus* (Laurenti, 1768) (Wilkin and Scofield, 1990; Creemers, 2000; Merilä and Sterner, 2002).

In the Netherlands, *H. medicinalis* has a limited distribution and often shares its habitat with amphibian species that are uncommon or rare in the country. One of these species is the Common Spadefoot Toad, *Pelobates fuscus*, which co-exists with *H. medicinalis* in riverine habitats and fens in the south and east of the Netherlands (Felix and van der Velde, 2000; Crombaghs et al., 2009). Parasitism by *Hirudo* has been described in the literature: Lenders (2015) and Mikitinez (2013) found bite marks of *H. medicinalis* on a dead adult *P. fuscus*, with Mikitinez also reporting on living *P. fuscus* with *H. medicinalis* attached to it, while Williams et al. (2020) identified *P. fuscus* as prey of the closely related *H. verbana* via an analysis of gut content mitochondrial DNA. However, records of leeches feeding on amphibian larvae are relatively scarce (e.g., Wilkin and Scofield, 1990; Winkler and Manzke, 2014). Feeding by leeches on spadefoot toad tadpoles has not been described in the literature, even though the relatively large size of the tadpoles makes them a substantial prey item for *H. medicinalis*. Here we describe feeding of *H. medicinalis* on both tadpoles and adults of *P. fuscus*, and we discuss the potential impact on spadefoot toad populations and syntopically occurring amphibian species.

Observations were made at two different sites in the Netherlands. The pond where we recorded a leech feeding on a tadpole is located on the landward side of a dike next to the Waal River close to the city of Ewijk. During the monitoring season of 2024, the pond had a surface area of about 9700 m^2, but during years with less precipitation the surface area shrinks considerably. The pond is well-vegetated, has low turbidity, and a maximum depth of about 2 m. All banks are gently sloped with shallow areas, which are accessible to cows.

On 26 June 2024 we observed a *P. fuscus* tadpole with a *H. medicinalis* attached to its body (Fig. 1). The tadpole swam away from the observer with the leech still attached. At the time of observation, the leech had not grown significantly in size from its unfed morphology, likely indicating that it was only beginning to feed. The tadpole was about 10 cm long. Eight other unparasitised tadpoles of similar sizes were observed in the same pond. *Hirudo medicinalis* was commonly seen in this pond, both in the shallow and deeper areas. The leeches were identified based on their characteristic colour pattern (Neubert and Nesemann, 1999). During an earlier visit to the same pond in 2024, we found a dying *L. vulgaris* being preyed on by several *H. medicinalis*.

The observation involving an adult *P. fuscus* was made on 19 April 2023 in the Overasseltse en Hatertse

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Vennen, south of the city of Nijmegen. In this area there are many fens, some of which are inhabited by *P. fuscus* and *H. medicinalis*. The observation was made in a well-vegetated mesotrophic fen with a surface area of 2076 m^2 and maximum depth about 1.5 m. We observed an adult male *P. fuscus* floating on the water surface with an attached *H. medicinalis* (Fig. 2). The leech was only attached via the posterior sucker at the mid-body of the spadefoot toad and appeared to be searching for a location to bite and extract blood. Despite efforts by the spadefoot toad to dislodge the leech by kicking with its hind legs, it remained attached during the short period of observation. We do not know if the feeding attempt succeeded. Similar to our other observation, identification of the leech was based on its characteristic colour pattern (Neubert and Nesemann, 1999).

Our observation adds another tadpole to the list of *H. medicinalis* prey. Especially for *Pelobates* tadpoles, which have a thin skin relative to their size (Nöllert, 1990) and are easily injured, attacks of medicinal leeches seem likely to have a lethal effect. Compared to the usually smaller tadpoles of sympatric amphibian species, *Pelobates* tadpoles are also a more substantial prey item for medicinal leeches. Because of the accuracy in locating their prey, guided by water vibrations (Dickinson and Lent, 1984), the likelihood of a medicinal leech attacking a large *Pelobates* tadpole is greater than for smaller tadpoles. Furthermore, because *H. medicinalis* is mostly active at high water temperatures (Elliott and Tullett, 1986), their peak activity coincides with the period that *P. fuscus* tadpoles are in their last developmental stages. We hypothesise that *P. fuscus* tadpoles are a usual prey item for *H. medicinalis* at this location.

The impact of medicinal leeches on amphibians is not often studied at the population level. Merilä and Sterner (2002) reviewed cases of attacks of medicinal leeches on amphibians, including some cases of severe impact on amphibian populations in a breeding pond. Although we have no standardised data on this matter, we cannot exclude the possibility that the presence of *H. medicinalis* affects amphibian populations at our monitoring sites. Most records in the literature describe parasitism or predation on adult amphibians, while only a few records exist of predation on tadpoles. For example, Wilkin and Scofield (1990) found dead larvae of *Pelophylax ridibundus* that had been killed by leech predation. However, it seems plausible that feeding of leeches on tadpoles remains largely undetected. Especially for species with a low number of relatively large tadpoles, whose adults spend only a short period in the water, tadpole predation is likely to be an important factor in reproductive success. Thus, the presence of medicinal leeches likely lowers the survival rate of larval and adult *P. fuscus* at our study sites. We presume that, especially with a high abundance of *H. medicinalis*, effects on local populations of *P. fuscus* cannot be excluded. However, to gain more insight into the influence of leeches on amphibian population dynamics, studies on the quantitative impact of medicinal leeches on amphibian populations are essential.

Figure 1. Feeding attempt of *Hirudo medicinalis* on a *Pelobates fuscus* tadpole in The Netherlands. Still frame taken from a video by Mick Vos.

Figure 2. Feeding attempt of *Hirudo medicinalis* on an adult *Pelobates fuscus* in The Netherlands. Photo by Jöran Janse.

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