

Whodunnit? Mass predation event of a breeding population of the Western Spadefoot Toad, *Pelobates cultripes* (Cuvier, 1829), in northern Portugal

Marisa Naia^{1,2,3,*}, Xavier Porcel^{1,2}, Samuel Andrade^{2,4}, Luca Di Giorgio^{1,2}, and Angelica Crottini⁵

Amphibians play a central role in freshwater and terrestrial food webs and are prey to a wide range of taxonomic groups (Wells, 2007). In the Iberian Peninsula, adult Western Spadefoot Toads, *Pelobates cultripes* (Cuvier, 1829), are known to be preyed upon by a variety of vertebrates, including snakes, birds and mammals (Recuero, 2014). Predation pressure is particularly relevant during the reproductive season, since this species tends to reproduce explosively (Lizana et al., 1994). While this strategy maximises reproductive output, it also increases vulnerability to opportunistic carnivores capable of exploiting these aggregations (Cogălniceanu et al., 2010). Observations of mass predation events of amphibians are underreported in the literature but have been documented in breeding populations of various anurans, providing insight into predator-prey dynamics during these events (Olson, 1989; Shillaker and Roberts, 2017).

On 18 November 2025, at 10:31 h, during a pond survey to monitor species presence, we observed a mass predation event of *P. cultripes* in a temporary dune pond that functions as one of the preferred breeding sites for

this species in the Mindelo Ornithological Reserve, Portugal (41.3185°N, 8.7378°W; 3 m elevation; Fig. 1A–C). The pond, spanning around 300 m² and with a maximum depth of 30 cm, showed high water levels following heavy rains. A total of 28 individuals of *P. cultripes* were found with visible signs of predation together with approximately 10 conspecific egg strings that seemed to be intact in the water. The carcasses were fresh and one maimed individual was found still alive, suggesting that the predatory event occurred during the previous night or in the early morning. The individuals were partially consumed, with 15 individuals missing hind limbs and at least one forelimb, nine missing only hind limbs, and two instances of isolated heads. One left foot, skin fragments and viscera were also observed across the pond.

We returned to the site on 20 November 2025 at 17:43 h, and found an additional seven dead individuals of *P. cultripes* along the margins of the same temporary pond (41.3189°N, 8.7375°W; 3 m elevation; Fig. 1D). These individuals were already desiccated and showed identical signs of predation (including the removal of hind limbs in four individuals and all four limbs in two other specimens). Due to a lack of precipitation and higher temperatures, the water level had rapidly decreased. Therefore, it is unclear if these individuals were eaten during the same night as the others and remained undetected below water on the day of the first observation, or if they represent a separate predation event. At the same site we also observed a dead male of the Lusitanian Parsley Frog, *Pelodytes atlanticus* Diaz-Rodriguez et al., 2017, but the absence of predatory marks suggested the cause of death could be unrelated.

In total, 34 adult carcasses of *P. cultripes* were recorded: 12 females, 10 males, and 12 undetermined specimens. From these, 31 individuals were collected, inspected, prepared and deposited in the herpetological collection of the Natural History and Science Museum of the University of Porto (MHNCUP_ID: MHNCUP/

¹ Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre s/n, 4169-007 Porto, Portugal.

² Centro de Investigação em Biodiversidade e Recursos Genéticos, CIBIO/InBIO Laboratório Associado - BIOPOLIS Program in Genomics, Biodiversity and Land Planning, Campus de Vairão, Universidade do Porto, 4485-661 Vairão, Portugal.

³ CIIMAR, Centro Interdisciplinar de Investigação Marinha e Ambiental, Universidade do Porto, 4450-208 Matosinhos, Portugal.

⁴ Departamento de Biologia, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.

⁵ Dipartimento di Biologia, Università degli Studi di Firenze, Via Madonna del Piano 6, 50019 Sesto Fiorentino, Italy.

* Corresponding author. E-mail: marisanaia@cibio.up.pt



Figure 1. (A) Temporary dune pond in the Mindelo Ornithological Reserve, northern Portugal, where the mass predation event was observed. (B) Two preyed upon *Pelobates cultripes*. (C) Detail of injuries on skin and limbs. (D) Dry carcass of *P. cultripes* found on 20 November 2025. Photos by Marisa Naia.

AMP0824 to MHNCUP/AMP0854). For each specimen, a tissue sample was collected and stored in 90% ethanol.

Although avian predation was initially considered, as both aquatic (Novarini and Stival, 2017) and terrestrial (Olson, 1989) birds are known predators of anurans, microscopic bone analysis on six individuals revealed tooth marks suggestive of a mammalian predator (Fig. 2A-D). Reported carnivores from the reserve include *Vulpes vulpes* (Linnaeus, 1758), *Mustela nivalis* Linnaeus, 1758 (Andrade and Martins, 2021) and, potentially, the invasive *Neogale vison* (Schreber, 1777).

To identify the predator, we deployed two camera traps facing the pond on 26 and 28 November 2025 (operating between 17:00–08:00 h). On the first night,

we recorded an Eurasian Otter, *Lutra lutra* (Linnaeus, 1758), entering the pond (Fig. 3). A Red Fox (*Vulpes vulpes*) was also recorded foraging in the vicinity on both nights. While previously reported anecdotally, this observation is the first formal confirmation of *L. lutra* within the protected area.

Considering the species captured by camera trapping, the observed feeding pattern at the site where the mass predatory events were reported, and prior documentation of analogous events (Lizana and Pérez Mellado, 1990; Ayres and García, 2007), we suggest that the most likely predator was the Eurasian Otter. This mustelid has strongly aquatic habits and exhibits a specialised behaviour toward capturing and feeding on amphibians, which include skinning the prey, discarding the head to

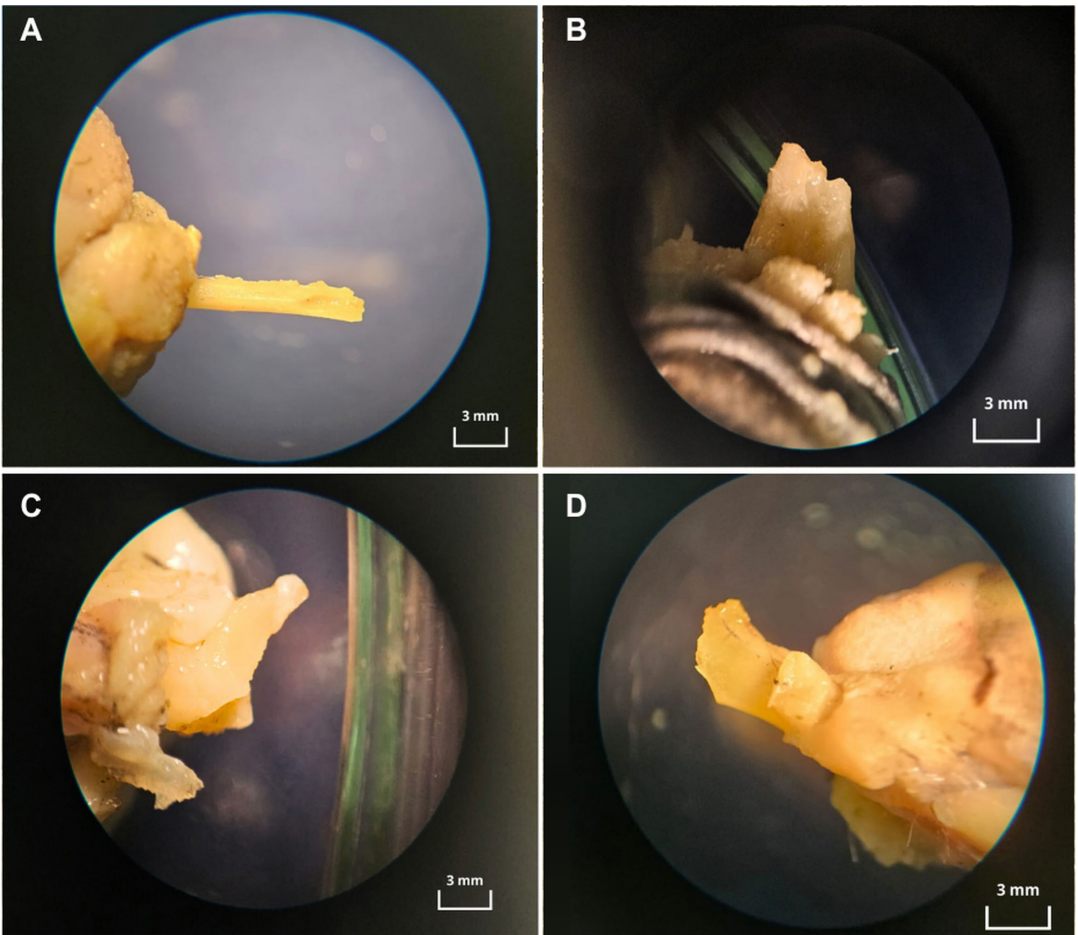


Figure 2. (A–D) Teeth marks on the bones of four individuals of *Pelobates cultripes*, suggesting a carnivore preyed upon these individuals. Photos by Marisa Naia.

avoid the ingestion of parotoid toxins, and selectively eating hind limbs (Lizana and Pérez Mellado, 1990; Morales et al., 2015). However, due to the absence of direct observation of the predation event, it remains unknown whether additional individuals might have been consumed in their entirety. The Eurasian Otter is known as an opportunistic carnivore, which leverages sporadic high food availability, including the consumption of amphibians during their reproductive season (Lizana and Pérez Mellado, 1990; Clavero et al., 2005). This type of event was previously reported both in *P. cultripes* and in other amphibian species (Ayres and García, 2007; Cogălniceanu et al., 2010; Almeida et al., 2013). The recorded mass predation event followed a series of storms and heavy rainfall that flooded both the protected area and surrounding landscapes. These

conditions likely triggered both an explosive breeding event in *P. cultripes* (Salvador and Carrascal, 1990; Lizana et al., 1994), as well as the dispersal of aquatic species such as *L. lutra*, into the reserve. The high prey availability during this explosive breeding event probably enabled the predator to exhibit a selective feeding behaviour.

The Red Fox was excluded because canids typically consume smaller prey whole and rarely feeds on amphibians (Sidorovich et al., 2006). Similarly, we discarded other potential predators such as the domestic cat and rats, as domestic felids tend to avoid aquatic habitats, while rodents lack the specialised manipulation skills required to perform this selective consumption. We cannot completely exclude the invasive American Mink (*Neogale vison*), as this species is expanding



Figure 3. Eurasian Otter (*Lutra lutra*) captured on camera trap at the temporary pond where the mass predation event occurred. Image brightness and contrast were adjusted for clarity using GIMP, and the image was cropped to improve subject visibility.

southward, with records as close as 10 km north of the protected area (Alves, 2025). Similarly to *L. lutra*, the American Mink can benefit from flood events to expand its range and shares a similar diet (Wise et al., 1981). However, the lack of direct observations of this species in the area and known feeding behaviour point towards *L. lutra* as the most likely predator.

In the Mindelo Ornithological Reserve, *P. cultripes* is considered a common species (Velo-Antón, 2020). However, our ongoing field observations indicate that the population is experiencing reproductive failure due to anthropogenic habitat modification and the premature desiccation of temporary ponds, particularly during dry years. The scarcity of suitable breeding sites, exacerbated by the disappearance of several temporary ponds due to the constructions of wooden paths, forces the species to aggregate in fewer deeper ponds, consequently increasing their vulnerability to predation. *Pelobates cultripes* is listed as Vulnerable under the IUCN Red Listing criteria (Salvador et al., 2024). Explosive breeding strategies can buffer the population against natural stochastic events like mass predation. Indeed, egg strings laid during this event have survived, and larvae developed successfully due

to favourable winter precipitation. Nevertheless, as existing anthropogenic pressures already diminish the species' overall resilience, predation events of this magnitude may have a substantial impact on the numbers of mature individuals of this population.

Acknowledgments. We thank everyone involved in unravelling this predator mystery for exchanging fruitful ideas: Francisco Álvares, Luís Silva, Martim Melo, Miguel Carretero, Pedro Andrade and Pedro Martins. This work was supported by the Vila do Conde Municipality and Fundação para a Ciência e Tecnologia (FCT) through the individual PhD fellowships 2023.02820.BD, 2023.01290.BD and 2024.00792.BD to MN, XP and LDG, respectively. This work was conducted under the research permit N° 513 / 2025 / CAPT issued by the Instituto da Conservação da Natureza e das Florestas (ICNF).

References

- Almeida, D., Rodolfo, N., Sayer, C.D., Copp, G.H. (2013): Seasonal use of ponds as foraging habitat by Eurasian otter with description of an alternative handling technique for common toad predation. *Folia Zoologica* **62**: 214–221.
- Andrade, P., Martins, P. (2021): Fauna terrestre da Paisagem Protegida Regional do Litoral de Vila do Conde e Reserva Ornitológica de Mindelo. APAP. Portugal.
- Ayres, C., García, P. (2007): Depredación de nutria *Lutra lutra*

- (Linnaeus, 1758) sobre sapo común *Bufo bufo* (Linnaeus, 1758) en el LIC Gándaras de Budiño (Galicia). *Galemys* **19**: 45–50.
- Alves, A. (2025): iNaturalist observation. Available at <https://www.inaturalist.org/observations/304264029>. Accessed on 27 January 2026.
- Clavero, M., Prenda, J., Delibes, M. (2005): Amphibian and reptile consumption by otters (*Lutra lutra*) in a coastal area in southern Iberian Peninsula. *Herpetological Journal* **15**: 125–131.
- Cogălniceanu, D., Márquez, R., Beltrán, J.F. (2010): Impact of otter (*Lutra lutra*) predation on amphibians in temporary ponds in Southern Spain. *Acta Herpetologica* **5**: 217–222.
- Lizana, M., Márquez R., Martín-Sánchez, R. (1994): Reproductive Biology of *Pelobates cultripes* (Anura: Pelobatidae) in Central Spain. *Journal of Herpetology* **28**: 19–27.
- Lizana, M., Pérez Mellado, V. (1990): Depredación por la nutria (*Lutra lutra*) del sapo de la Sierra de Gredos (*Bufo bufo gredosicola*). Doñana, *Acta Vertebrata* **17**: 109–112.
- Morales, J., Ruiz-Olmo, J., Lizana, M., Gutiérrez, J. (2016): Skinning toads is innate behaviour in otter (*Lutra lutra*) cubs. *Ethology Ecology & Evolution* **28**: 414–426.
- Novarini, N., Stival, E. (2017): Wading birds predation on *Bufo viridis* (Laurenti, 1768) in the Ca'Vallesina wetland (Ca'Noghera, Venice, Italy). *Bollettino del Museo di Storia Naturale di Venezia* **67**: 71–75.
- Olson, D.H. (1989): Predation on breeding western toads (*Bufo boreas*). *Copeia*: 391–397.
- Recuero, E. (2014): Sapo de espuelas – *Pelobates cultripes*. In: Enciclopedia Virtual de los Vertebrados Españoles. Salvador, A., Martínez-Solano, I., Eds., Museo Nacional de Ciencias Naturales, Madrid. Available at <http://www.vertebradosibericos.org/>. Accessed on 27 January 2026.
- Salvador, A., Carrascal, L.M. (1990): Reproductive phenology and temporal patterns of male access in mediterranean anurans. *Journal of Herpetology* **24**: 438–441.
- Salvador, A., Díaz-Paniagua, C., Recuero G.E., Martínez-Solano, I., Bosch, J., Thirion, J.-M., et al. (2024): *Pelobates cultripes*. The IUCN Red List of Threatened Species **2024**: e.T58052A228187495. Accessed on 27 January 2026.
- Shillaker, R., Roberts, M. (2017): Mass mortality of adult Common Toads at two breeding sites in Yorkshire. *The Naturalist* **142**: 178–190.
- Sidorovich, V.E., Sidorovich, A.A., Izotova, I.V. (2006): Variations in the diet and population density of the red fox *Vulpes vulpes* in the mixed woodlands of northern Belarus. *Mammalian Biology* **71**: 74–89.
- Velo-Antón, G. (2020): Amphibian micro-hotspot at the Mindelo Ornithological Reserve (Porto, Portugal). *Boletín de la Asociación Herpetológica Española* **31**: 151–155.
- Wells, K.D. (2007): *The Ecology and Behavior of Amphibians*. Chicago, USA, Chicago University Press.
- Wise, M.H., Linn, I.J., Kennedy, C.R. (1981): A comparison of the feeding biology of mink (*Mustela vison*) and otter (*Lutra lutra*). *Journal of Zoology, London* **195**: 181–213.