

First case of predation of the Tyrrhenian endemic Sardinian tree frog *Hyla sarda* by an alien water frog *Pelophylax* sp. in northern Sardinia, Italy

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Sardinia is the second largest island in the Mediterranean Sea, located in the centre of its western basin, and represents an important biodiversity hotspot for amphibians (Di Nicola & Mezzadri, 2018; Bellati et al., 2019). The island is currently populated by six species of urodeles and at least six anuran species including two recently introduced *Pelophylax* spp. (Pous et al., 2012; Di Nicola & Mezzadri, 2018; Cossu et al., 2018; Bellati et al., 2019).

Various species of water frog *Pelophylax* spp. are distributed throughout Europe, Asia and North Africa; it is not always possible to base their identification on morphology and bioacoustics, instead molecular analyses are often required (Bellati et al., 2019). In peninsular Italy and Sicily, *Pelophylax lessonae* is present as a native species (with the subspecies *P. l. lessonae* and *P. l. bergeri*); moreover, there is the hybrid taxon *Pelophylax* kl. *esculentus* (see Schultz, 1969 and Bellati et al., 2019 for hybridisation mechanisms) and the alien taxa *Pelophylax* cf. *bedriagae*, *Pelophylax ridibundus* (whose native range may be limited to the extreme north-east of Italy) and *P.r. kurtmuelleri* (Di Nicola et al., 2021; Sindaco & Razzetti, 2021). Alien water frogs are invasive and have been introduced mainly for culinary and scientific reasons (Bruni et al., 2019).

As regards the alien species reported for Sardinia, the low reliability of field identification limits the checklist only to taxa that have been characterised on a molecular basis. So far, the Balkan frogs (*P. r. kurtmuelleri*) and two cryptic taxa of the “*bedriagae*” group (*P. cf. bedriagae*) have been confirmed for the island and their occurrence is related to multiple and independent release events, at least partially due to translocations from central Italy during commercial activities such as plant cultivation, sports fishing and food supply (Bellati et al., 2019). Furthermore, introductions of taxa from the Italian mainland have also been reported in the past (see Corona & Fanzago, 1880; Sochurek, 1955; Tortonese & Lanza, 1968; Lanza, 1983a; Bellati et al., 2019) but the current presence on the island needs to be confirmed.

The water frog species found in Sardinia can exceed 100 mm of snout-urostyle length (Di Nicola et al., 2021). They are active both day and night and their diet consists mainly of invertebrates, but they can prey upon small fish, amphibians (including tadpoles and adults, even of the same species) and also lizards (Nicolau et al., 2014; Plitsi et al., 2016; Bam-e-Zar



Figure 1. Alien water frog preying on a Sardinian tree frog in Lake Baratz, Sardinia

et al., 2019; Katsiyiannis & Tzoras, 2020; Di Nicola et al., 2021).

Here we report a case of predation by an alien water frog of a Sardinian tree frog *Hyla sarda*, an anuran endemic to the Tyrrhenian islands. *Hyla sarda* is a monotypic species found in Sardinia (including some smaller islands), Corsica (including the island of Cavallo) and the Tuscan Archipelago (Elba Island and Capraia). Adults have a snout-urostyle length on average less than 40 mm, with a maximum of 55 mm (Corti, 2007; Di Nicola et al., 2021). It is mainly a nocturnal species and among the Italian tree frogs it seems to be the species most linked to water, found on riparian or emerging vegetation even in the height of summer (Lanza, 1983b; Corti, 2007; Speybroeck et al., 2016). Its predators include snakes, mammals and birds (Corti, 2007; Di Nicola & Mezzadri, 2018) but there are no reports of predation by other amphibians.

On 9 August 2021 at 00:21 h, in Lake Baratz (Province of Sassari, Sardinia; 40° 40'53" N, 8° 13'19" E; 26 m a.s.l., clear weather, T_{min} 20 °C, T_{max} 35 °C), one of the authors (JRF) observed an adult water frog with a Sardinian tree frog in its mouth (Fig. 1). The tree frog was being swallowed head first with the legs hanging from the mouth. After photographs were taken, the predator moved away keeping the prey firmly in its mouth. The water frog stood on the aquatic vegetation in water less than 5 cm deep, at about 70 cm from

the shore, together with a very large number of congeners, some of which were calling. On the riparian vegetation there were many individuals of *H. sarda* (approximately more than 60 individuals in about a 100 m stretch, none of which were calling) but no individuals were observed on aquatic vegetation together with water frogs. An adult *Bufo viridis balearicus* was also spotted on the shore.

It is known that water-related species such as amphibians are particularly sensitive to changes caused by the presence of non-native fauna (Bucciarelli et al., 2014). In areas where native water frogs exist, the aliens represent a problem due to the ease with which different taxa can hybridise in the wild and due to local competition. Alien species represent a threat also in Sardinia (where there are no indigenous water frogs), since their presence implies competition, predation and the spread of pathogens at the expense of native amphibian fauna (Bellati et al., 2019).

Pelophylax spp. are opportunistic feeders and eat almost any prey they can find, including tree frogs when terrestrial (Katsiyannis & Tzoras, 2020). *Hyla sarda* is categorised as of Least Concern on the IUCN red list and the population in Sardinia is still considered stable (IUCN Italian committee, 2013; IUCN, 2020). However, the recent introduction and expansion of species such as *P. r. kurtmuelleri* and *P. cf. bedriagae* could pose a conservation threat. It is therefore important to carry out further field surveys to assess the extent of the impact of the alien water frogs on native anurans and, if need be, evaluate possible actions to limit the problem.

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