

A record of cannibalism in *Podarcis muralis* (Laurenti, 1768) (Reptilia, Lacertidae) from Slovenia

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The common wall lizard *Podarcis muralis* (Laurenti, 1768) is, among the continental European lacertid lizards, the species that occurs in the highest local densities. Its distributional range covers most of Central and part of southern Europe (Gasc et al., 1997). In Slovenia, *P. muralis* occurs throughout the country except for the most north-eastern region (Krofel et al., 2009). While it inhabits a wide variety of habitats, it prefers dry, sunny and stony places, although can also be found in shady and overgrown areas (Arnold, 1987; Arnold and Ovenden, 2002).

Small lacertid lizards from mainland populations mostly prey on insects and spiders (Arnold, 1987; Arnold and Ovenden, 2002), but also consume prey from many other orders of Arthropoda, some gastropods and even some small vertebrates and plant material (Arnold, 1987; Van Damme, 1999; Carretero, 2004), herbivory being more prevalent in island populations (Cooper & Vitt, 2002). Prey selection by lacertids depends on various abiotic and biotic factors (see: Arnold, 1987; Diaz and Carrascal, 1993; Pérez-Mellado and Corti, 1993; Capula and Luiselli, 1994; Herrel et al., 1999; Vervaijen, Van Damme and Herrel, 2002; Carretero, 2004). In particular, cannibalism in lacertids has been linked to island populations as a symptom of scarce resources and high lizard densities (e.g. Pérez-Mellado and Corti, 1993), although the occurrence and circumstances of cannibalism in continental populations have not been well documented. By definition, cannibalism is a special form of predation in which the predator and the prey are members of the same species. Generally, a cannibal individual is considerably larger than its victim (e.g. Polis; 1981). Cannibalism may

have ecological impacts on demographic structure and population processes. For instance, a moderate level of cannibalism reduces intercohort competition, enabling coexistence of many cohorts (Claessen, Roos and Persson, 2000), a phenomenon referred to as the “lifeboat mechanism” (saving a population from extinction) (e.g. Cushing, 1991). This can lead either to multiple stable states in a population (Cushing, 1991, 1992) or, in other circumstances, to population oscillations (Cushing, 1991). In most species of reptiles cannibalism appears to occur opportunistically as a by-product of normal predatory behaviour (Polis and Myers, 1985).

Many studies on the dietary preferences of *P. muralis* from different parts of its distributional range have shown that it predominantly feeds on invertebrates such as Coleoptera, Homoptera, Isopoda, Diptera, Lepidoptera, Araneae, Formicidae and other Hymenoptera (Strijbosch, Bonnemayer and Dietvorst,



Figure 1. Adult individual of Common wall lizard, *Podarcis muralis*, consuming a juvenile conspecific at the Žovnek castle ruins, Vrankso, central Slovenia. Photo: Anamarija Žagar.

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1980; Mou, 1987; Capula, Luiselli and Rugiero, 1993; Pérez-Mellado and Corti, 1993; Richard and Lapini, 1993). In a review of the available literature we found only three previous reports of cannibalistic behaviour in *P. muralis*: from Kabischki Engelmann (1964) in East Bulgaria (in Polis and Myers, 1985) and from Assman (1997) and Schmidt-Loske (1994) (in Schulte, 2008). In all reported cases adult males consumed a juvenile conspecific. Several cases of cannibalism have been reported for other species from this genus: e.g. for *P. sicula* from Central (Rugiero, 1994; Grano, Cattaneo and Cattaneo, 2011) and southern Italy (Capula and Aloise, 2011) and from an introduced population in New York (Burke & Mercurio, 2002); for *P. (hispanica) atrata* from Columbretes Islands (Castilla, 1995; Castilla and Van Damme, 1996); for *P. filfolensis* from Linosa and Lampione islands in Palagian Archipelago (Bombi et al., 2005; Carretero et al., 2010), and for *P. gaigeae* from Skyros (Adamopoulou, Valakos and Pafilis, 1999).

During field work at Vransko in central Slovenia (46.2456°N, 14.9526°E), on 29 July 2007 at the ruins of the Žovnek castle an adult male of *P. muralis* was observed preying on a juvenile conspecific. Observation began when the predator had already swallowed half of its prey (the posterior of the body and rear legs were outside the predator's mouth) and a few minutes later only half of the tail remained uningested (Fig. 1). The prey item was identified by the dorsal colouration pattern of the rear body and legs. The predation event took place in the afternoon at 16:48 and the lizard was in a shady spot on a wooden bridge. The location is at elevation of 392 m a.s.l. and the air temperature at the nearest meteorological station at 14:00 on that day was 26.1°C (Celje). After swallowing the whole prey, the lizard escaped into a hiding place beneath the wooden bridge.

During reptile sampling at this location five counts were made of individuals of *P. muralis* throughout the day, each count using the same sample effort and method. Relatively high density numbers were observed for *P. muralis* at this part of their distribution range. The maximum number found was at 12:00 when 52 adults were counted in five minutes by four observers moving slowly around the castle ruins in an area of approx. 1500 m².

High density of *P. muralis* could be one of the factors facilitating the cannibalistic behaviour at this locality, together with the presence of abundant hatchlings at this time of year. Polis (1981) suggested that cannibalism could be a density self-regulation

process in populations with high densities, as we suggest in our case. Interestingly, all known reports of cannibalism in *P. muralis* have observed an adult male preying on a juvenile conspecific (in Polis and Myers, 1985; Schulte, 2008). Adult males also appeared to be more cannibalistic than females in *P. (h.) atrata* from Columbretes islands (Castilla and Van Damme, 1996). *P. muralis* males are known to be more aggressive than females and exhibit territorial behavior (Schulte, 2008). In terms of head morphology, males have relatively wider and higher heads (Gracceva et al., 2008; Aleksić et al., 2009; Žagar et al., in press) and a stronger bite force (Kaliontzopoulou et al., 2012). Therefore, it is expected that males, rather than females, would predate a large prey item such as a juvenile.

Although this phenomenon must be infrequent in continental populations, it may have been underestimated due to the small window of opportunity in terms of time and space (hatching period and high population density). Because of both the high energy reward to the predator and the considerable ecological importance for intraspecific competition, lizard cannibalism certainly deserves further investigation even in continental habitats.

Addendum: During the revision process of this paper, the first author made another observation of a male *P. muralis* swallowing the tail of a conspecific in a location in South Slovenia. In this case, the possibility cannot be ruled out that the animal was consuming the autotomized tail, rather than a whole animal, because swallowing of the tail was observed. Nevertheless, this additional observation reinforces the idea that cannibalism is more frequent than reported in the literature.

Acknowledgements. We would like to thank Dr Bronwen Presswell for corrections in regard to the use of English.

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