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Can I borrow your burrow? Use of the burrows of *Geolycosa vultuosa* (Araneae: Lycosidae) by *Podarcis tauricus* (Squamata: Lacertidae)

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Abstract.. Underground hiding places are important shelters for many species. After surveying 427 burrows made by wolf spiders *Geolycosa vultuosa* in Carei Plain in north-western Romania, in 10 of them we identified individuals of *Podarcis tauricus*. Lizards use the lycosid burrows as retreat sites, but they seem to be limited to those already abandoned by spiders. Nevertheless, these might represent valuable alternative refuges from harsh environmental conditions or predators.

Key words: burrow, *Podarcis tauricus*, *Geolycosa vultuosa*, hiding, sand, lizard, wolf spider.

Podarcis tauricus (Pallas, 1814), the Crimean wall lizard, is a widely distributed lizard species occurring in south-western Ukraine, eastern and southern Romania, south-eastern Hungary, Czech Republic, Macedonia, Bulgaria, Greece, western Turkey, Albania, southern Moldova (Fischer et al. 2019, Uetz et al. 2020). If prefers habitats with sparse steppe vegetation (Fischer et al. 2019), being found on dry, loose sandy soil (Dely 1978), but also in heavily grazed areas or other perturbed sites (Covaciu-Marcov et al. 2006). It digs oblique burrows into the ground or uses empty mouse holes to hide during night and rainy days, as well as to escape from predators (Dely 1978).

Geolycosa vultuosa (C. L. Koch, 1838) is a lycosid found in sandy grasslands with various grazing intensity, fallows or abandoned lands (Szinetár et al. 2012, Sas-Kovács & Sas-Kovács 2014) located in Slovakia, Hungary, south-eastern and eastern Europe, Turkey, Caucasus, Iran (World Spider Catalog 2020). These spiders live in 16-20 cm deep burrows dug into the ground, and hunt insects at their entrance (Fuhn & Niculescu-Burlacu 1971).

Underground hiding places are important for various taxa. Temperature and humidity inside them is much more constant, without the drastic outside variations, extremely useful for animals living in arid environments (Gálvez Bravo et al. 2009). Having a burrow in which to shelter it also helps in avoiding predation (Dely 1978, Kiss 1985, Williams et al. 2006, Manicom et al. 2008). There are animals that dig their on burrows, while others use as shelter burrows made by spiders, mammals, these giving them the opportunity to colonize habitats otherwise unfavorable for them (Gálvez Bravo et al. 2009, Ebrahimi & Bull 2012). Here we report an association between a lizard and a spider species, the presence of Crimean wall lizards in burrows of *G. vultuosa*.

In 2014 and 2017, as part of a larger study on the ecology of wolf spiders, there were investigated five habitats occupied by *G. vultuosa* and *P. tauricus*, in north-western Romania, in Carei Plain, where the distribution of this wolf spider species is quite well known (Sas-Kovács & Sas-Kovács 2014). Each habitat was visited twice: in spring and autumn. To assess if the burrow is inhabited or not we used the camera of a Voltcraft BS-50X endoscope.

There were surveyed a total number of 427 burrows, Crimean wall lizards being found in 2.34% of them, i.e. 10 burrows (Figure 1). Seven of them were identified in autumn

Figure 1. *Podarcis tauricus* and *Geolycosa vultuosa* inside the burrows as viewed on the camera of the endoscope.

in one habitat, and the other three during spring at two different sites (Figure 2). The average length of the occupied burrow entrance was 14.10 mm (± 2.05), and the average width was 13.43 mm (± 2.55). One of them had a 5 mm high turret, and another had freshly excavated sand around the entrance.

The presence of the turret, respectively of the fresh sand near the entrance of the burrow, clearly shows that those burrows were until recently used by spiders. Being dug in sandy soil, in order to persist, burrows need to be actively maintained. The fresh sand around the entrance could have come from the activity of widening or deepening or repairing the burrow by its inhabitant or from the activity of dig-

Figure 2. Aspects of the habitats occupied by *Podarcis tauricus* and *Geolycosa vultuosa* (the little flags on the first two images point out burrows' location).

ging a new one. But we do not know what happened to their original inhabitant. If it was a male, it is possible that he abandoned the burrow with the turret in search of females. After reaching maturity, males of this species become vagrant. *G. vultuosa* reproduces in autumn, (Fuhn & Niculescu-Burlacu 1971), and the identification of the lizard in this burrow happened towards the end of September.

Crimean wall lizards most likely have an opportunistic behavior, using burrows that are no longer utilized by spiders. The fact that most lizards have been identified in "unmaintained" burrows reinforces this consideration. In addition, most burrows that seemed deserted (absence of fresh sand near the entrance, no turret) were empty, i.e. no spider inside (personal observation) (Figure 3). The building of the turret is considered to have a defensive role, the higher and better decorated being, the lower is the predation risk on its dweller (Williams et al. 2006). *P. tauricus* may not want to feed on individuals of *G. vultuosa*, but if the burrow entrance is well camouflaged, it may remain completely hidden to lizards and they can neither have the chance to use it as shelter. The small number of burrows in which we identified lizards, suggests that they have limited access to this type of hiding place. In case of danger, they hide in cracks in the ground, cricket holes or abandoned rodent cavities (Dely 1978, Kiss 1985). In his book Kiss (1985) mentions that lizards can take refuge in the vertical subterranean burrows of wolf spiders, but gives as an example another species, *Lycosa singoriensis* (Laxmann, 1770). Therefore, to our knowledge, this is the first report of individuals of *P. tauricus* using

Figure 3. Empty burrow, and burrow with turret and freshly excavated sand

burrows of *G. vultuosa* as retreat sites.

Lizards take advantage of spiders, a profit that stands out both physically as a protection space and energetically, as lizards feed on spiders (Ebrahimi & Bull 2012). We did not record predation of Crimean wall lizard on *G. vultuosa*, but this is not excluded, as it is known that *P. tauricus* consumes spiders as well (Dely 1978, Kiss 1985, Mollow et al. 2012). However, there are no data on the size and identity of the consumed spiders. *G. vultuosa* is a fairly large lycosid, the prosoma length of males being on average 8.98 mm, and that of females 9.86 mm (Sas-Kovács et al. 2020), and they do not hesitate to take a threating posture when disturbed (personal observation). However, the pygmy bluetongue lizard (*Tiliqua adelaidensis*), with an average snout-to-vent length of 95 mm, which uses exclusively burrows made by lycosid and mygalomorph spiders, feeds on lycosids (Ebrahimi & Bull 2012). Crimean wall lizards are smaller, with average snout-to-vent length 61.16 mm (Eroğlu 2017), thus they may avoid attacking *G. vultuosa* individuals. On the other hand, there was reported that wolf spiders, with head to thorax length of 18.1 mm and 20.2 mm, respectively, successfully bit and killed lizards, most probably in order to avoid being predated by them (Ebrahimi & Bull 2012). In addition, when spiders were the predators, their lizard preys turned out to be significantly larger in size (for a review on lizard predation by spiders see: Reyes-Olivares et al. 2020). Various spider species may prey upon anurans, lizards and even mammals, though peaceful cohabitations, with various taxa, is also possible (Cocroft & Hambler 1989, Clayton et al. 2019, von May et al. 2019, Reyes-Olivares et al. 2020). It would be interesting to know the nature of the relationship between *G. vultuosa* and *P. tauricus*, hence, further studies are needed in this sense.

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