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Eat or be eaten? An observation of *Podarcis erhardii* consuming *Scolopendra cingulata* from Andros Island, Cyclades, Greece

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Abstract

Podarcis wall lizards mainly feed on coleopterans, orthopterans, arachnids, and other small invertebrates. However, Aegean wall lizards, *Podarcis erhardii*, are widely distributed across Aegean islands and are increasingly observed eating non-traditional food items ranging from plant material to conspecific eggs and body parts. Here, we report the first documented case of *P. erhardii* consuming a large centipede, *Scolopendra cingulata*. The predator-prey relationship between these species has appeared to go both ways and may intensify on islands.

Key Words

Chilopoda, Lacertidae, predator-prey relationship, venomous prey

The Aegean Wall Lizard, *Podarcis erhardii* (Bedriaga, 1882), is a small to medium-sized lacertid lizard native to the Southern Balkans and hundreds of Aegean islands (Valakos et al. 1999). Adult *P. erhardii* range from 45 mm to 80 mm in snout-vent-length (SVL). Island populations of *P. erhardii* experience negligible levels of gene flow (Hurston et al. 2009) and exhibit local adaptation in various traits including SVL and mass (Itescu et al. 2018), maximum bite force (Donihue et al. 2015), and feeding ecology (Brock et al. 2014; Madden and Brock 2018). Lizards from very small and very large islands tend to be larger and experience increased intraspecific aggression (Donihue et al. 2015; Stadler 2021), possibly due to high population densities that lead to more competition for access to habitat, food sources, and mates. *Podarcis erhardii* are often described as insectivores that feed mainly on coleopterans, orthopterans, and arachnids (Valakos et al. 1997; Valakos et al. 2008). Although some seasonal fluctuations of diet are present, during the summer and spring seasons, Coleoptera have been observed to be the most common prey for *P. erhardii* (Adamopoulou et al. 1999). However, *P. erhardii* from islands have been observed consuming food items such as vegetation and marine life (Brock et al. 2014). In extreme cases, they have also been seen eating the eggs, severed tails, and other body parts of other *P. erhardii* (Brock et al. 2014; Madden and Brock 2018). Unusual and cannibalistic feeding observations appear to be more common on islands with dense wall lizard populations (Pafilis et al. 2009; Donihue et al. 2015).

Scolopendra cingulata (Latreille, 1829) (Fig. 1A) is a carnivorous centipede and member of the family Scolopendridae. This predatory centipede is native to northern Africa and southern Europe and is the most common scolopendromorph in the Mediterranean (Simaiakis et al. 2011; Oeyen et al. 2014). *Scolopendra cingulata*

occurs on most Aegean islands, with the exception of Crete and its nearby satellite islands (Simaiakis et al. 2005). This centipede can reach up to 159 mm in length in the Aegean region (Simaiakis et al. 2011). Large scolopendromorphs can prey on small vertebrates (McCormick and Polis 1982), including toads, rats, and lizards (Zimic and Jelic 2014; Deimezis-Tsikoutas et al. 2020). Saurophagy (lizard consumption) has been observed in *S. cingulata*, and it has been photographed consuming *Dalmatolacerta oxycephala* (Duméril & Bibron, 1839) on the Dalmatian island of Korčula, Croatia, and *P. erhardii* on the Aegean island of Andros, Greece (Deimezis-Tsikoutas et al. 2020). It is a toxic predator that primarily relies on its venomous properties and frontal leg strength to immobilize and suffocate its prey (Lewis 1981; Cooper et al. 2014; Oeyen et al. 2014). Larger body masses and length often correlate with an increased venom yield in *S. cingulata* (Cooper et al. 2014).

Podarcis erhardii and *S. cingulata* both live in dry stone walls throughout the Aegean islands. Their daily activity periods, however, are mostly non-overlapping. *Podarcis erhardii* are more active during the day, while *S. cingulata* are most active at night (Deimezis-Tsikoutas et al. 2020). *Scolopendra cingulata* tend to thrive in environments with relatively low precipitation, relatively low air humidity, and relatively high average air temperatures, making them most active during the summer seasons (Kaltsas and Simaiakis 2012). The only documented predatory altercation between these two species was of *S. cingulata* eating a *P. erhardii* inside the crack of a stone wall during the day (Deimezis-Tsikoutas et al. 2020). However, other accounts of *S. cingulata* eating lacertid lizards (Zimic and Jelic 2014) suggest that interactions may be more common than first expected (Deimezis-Tsikoutas et al. 2020).

At 0930 on June 7 2022, while conducting fieldwork near Strapouries on the Aegean island of Andros (37°49'52.21384"N, 24°54'7.98102"E), we observed an adult male *P. erhardii* consuming a *S. cingulata* (Fig. 1B). The lizard was quickly traversing a sunny stretch of dry stone wall, and stopped every one meter or so to pause and adjust material that was hanging out of its mouth. While observing the lizard, we noticed that it would stop walking, throw its head back, and squeeze its sides together, suggesting it was trying to swallow the material hanging out of its mouth. We captured the distracted lizard with a lasso and took a photograph of the mostly consumed prey item (Fig. 1B). The legs protruding from the lizard's mouth were identified by L. Van Passel as *Scolopendra cingulata*. We observed the lizard for several hours to confirm that it completely consumed the toxic centipede. The lizard's snout-vent-length (SVL) was 74.8 mm and it weighed 11.3 g after consuming the centipede. This lizard was the 7th heaviest *P. erhardii* we measured from Andros in 2022 (Andros adult lizard mass ranged from 4.6 g to 12.2 g), and in the top 4% of SVL length we have measured from more than 40 islands since 2017 (Brock et al. 2022). This is the first recorded sighting of *P. erhardii* consuming *S. cingulata*.

This observation provides further evidence that *P. erhardii* can turn to unconventional, and even risky nutritional sources on islands (Castilla and Herrel 2009; Castilla et al. 2009). The toxic venom and aggressive nature of *S. cingulata* would otherwise make it an unfavorable food source that could inflict bodily harm, or even kill the lizard (McCormick and Polis 1982; Deimezis-Tsikouta et al. 2020). Risky feeding behavior by *P. erhardii* may be a result of local environmental pressures, food shortages, or a possible increase in the local presence of *S. cingulata*.

The presence of venomous prey can induce selection on the predator species based on age and size: smaller and younger lizards are more likely to suffer from the impacts of the toxic venom (Robbins and Langkilde 2012). In general, the larger the lizard, the higher its tolerance for venom and other toxins (Robbins and Langkilde 2012).

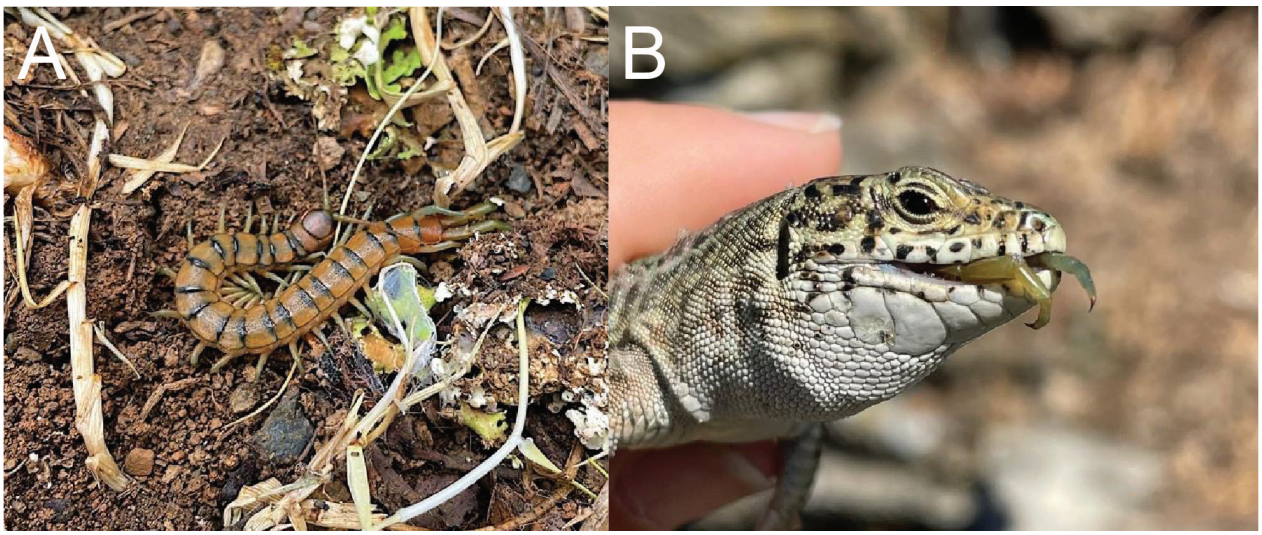

Figure 1. A. An adult *Scolopendra cingulata* (Photo by L. Van Passel); **B.** An adult male *Podarcis erhardii* consuming a *Scolopendra cingulata*. This observation was made near Apoikia, Andros island, Greece (Photo by K. M. Brock).

Therefore, for larger lizards, consuming venomous prey could be an evolved anti-predator response and may be an additional way to gain nutrients (Robbins and Langkilde 2012). Prior research shows that over time, predators may even benefit from consuming venomous prey in moderation (Herr et al. 2016). More exposure to toxic prey can allow predators to alter their feeding patterns and evolve to become more skilled at evading the prey's venomous mechanisms, potentially developing a form of resistance to the toxins (Herr et al. 2016). Given how closely *S. cingulata* and *P. erhardii* live in the cracks of dry stone walls (Deimezis-Tsikouta et al. 2020), understanding the frequency and nature of their predator-prey interactions is an interesting avenue of future research.

Andros is a relatively large island with more annual rainfall and lush vegetation compared to other Cycladic islands (Myronidis and Nikolaos 2021). Although this consumption could be an act of scavenging, it seems unlikely that other, less risky food sources are unavailable or even scarce to this lizard. On the other hand, *P. erhardii* reaches some of the highest recorded densities on Andros (Brock et al. 2015, 2022; Donihue et al. 2015), which may induce competition for food. Since arthropods, such as Coleoptera, have been observed to be the most common prey for *P. erhardii* during this season, this consumption is unusual (Adamopoulou et al. 1999). Although the motives for this consumption are still unclear, observations of food items outside of the coleopteran, orthopteran, and arachnid dietary preferences of *P. erhardii* are previously documented and tend to happen on islands (Brock et al. 2014; Donihue et al. 2015; Madden and Brock 2018). More research has to be conducted to determine the frequency of these events, and the history of the evolution of this behavior in *P. erhardii*.

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