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SHORT COMMUNICATION

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Observations on the diet of the nose-horned viper (*Vipera ammodytes*) in Greece

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The nose-horned viper *Vipera ammodytes* (L., 1758) is a widespread southern European species and the only one to possess a distinguishable soft nose-horn (Arnold & Ovenden, 2004). Among European snakes, it is notable in having the most potent venom (Latinović et al., 2016) and in south-east Europe is responsible for the majority of envenomations (e.g. Frangides et al., 2006).

Vipera ammodytes inhabits a variety of habitats but shows preference for rocky slopes and embankments where it preys on a range of animals. Prey preference has been found to change as these vipers grow. Luiselli (1996) found that small vipers (0-2 years old) preyed upon small lizards (100 %, *n*=24), larger and older specimens also consumed lizards, but their diet was predominantly passerine birds and mammals (65 %, *n*=80). Arthropods such as large insects and centipedes have regularly been found in the stomach contents of *V. ammodytes*, albeit more frequently in juveniles that eat small centipedes (e.g. Arnold & Ovenden, 2004; Heckes et al., 2005; Stille & Stille, 2017).

Two confirmed and one putative record of predation by two juvenile and one adult *V. ammodytes* are described herein. Precise collection data are not mentioned here as *V. ammodytes* is subject to poaching, especially for the pet-trade. However, locality data is available on reasonable request to the author.

Predation on the lizard *Ophisops elegans*

On 20 April 2017 at 16:45 h in Thrace, Greece (28 m asl), a juvenile *V. ammodytes* was found under a rock and was placed on a white cloth to enable photography. The snake proceeded to regurgitate an *Ophisops elegans*, identified from the distinguishing keeled dorsal scales and dorso-lateral stripes (Fig. 1A). The lizard's tail was folded and compressed (Fig. 1B), likely a result of the contracting intestinal muscles. No measurements were taken. This is the first record of this predator-prey interaction and additionally the folded tail of the lizard is an interesting observation (Fig. 1B). This compression of the food-item would appear to ensure an efficient fit in the gastrointestinal tract. Furthermore, many Mediterranean lizards have long tails, which if not somehow folded or compressed during ingestion could hinder the mobility of the predating snake.

Putative predation on a passerine bird *Passer* sp.

On 12 June 2019 at 12:32 h in Macedonia, Greece (62m asl) an adult roadkill *V. ammodytes* was found adjacent to a small dead passerine bird, *Passer* sp. (Fig. 1C). Both animals are estimated to have died within 2 h of their discovery. It appears that the adult snake had bitten and then pursued the bird on to the road where it was subsequently hit by a vehicle; passerine birds are well known prey of *V. ammodytes* (e.g. Luisella, 1996). The author has encountered an estimated 300 snakes, with a total of 101 confirmed roadkills, on roads in 10 countries over 4 years, but this is the first observation of one adjacent to a possible prey item.

Figure 1. Three specimens of *V. ammodytes* with various prey items – **A.** Juvenile adjacent to a regurgitated *O. elegans*, **B.** Close-up of the regurgitated *O. elegans* from Fig. 1A showing a folded tail, **C.** Adult roadkill found next to a dead passerine bird, **D.** Juvenile with a regurgitated centipede *S. cingulata*

Predation on a centipede *Scolopendra cingulata*

On 24 April 2017 at 08:59 h in Macedonia, Greece (62 m asl), a juvenile *V. ammodytes* was found beneath a small pile of rubble and due to the uniformly enlarged body and lack of a distinct bulge it was considered to be an overweight individual. The specimen's movements seemed rigid and

within 3 minutes of being placed on a white cloth for photography it had regurgitated an adult Mediterranean banded centipede *S. cingulata* (Fig. 1D). The snake had a snout-vent length of 174 mm. The centipede when measured from the anterior margin of the head shield to the end of the telson was 89 mm (body length), but with the antennae and posterior legs totalled 111 mm (total length). The mean body length of a *S. cingulata* in the Mediterranean was found to be 74 mm (*n*=474, Stylianos Simaiakis, pers. comm.), emphasising the magnitude of the successful predator-prey interaction recorded here (mean + 20 %).

Scolopendra cingulata is a large venomous species belonging to a family notorious for their aggressiveness and ability to subdue comparatively large prey, including mammals, birds, lizards, and snakes (e.g. Dugon & Arthur, 2012; Zimić & Jelić, 2014). There are three failed cases of predation and ingestion of adult *S. cingulata* by *V. ammodytes* in the literature (Clark, 1967; Tan & Kretzschmar, 2009; Arsovski et al., 2014) and at least one case of a *S. cingulata* eating a 170 mm *V. ammodytes* (observation by Sochurek in Biella (1983)). Clark (1967) and Arsovski et al. (2014) both reported cases of juvenile *V. ammodytes* that had ingested adult *S. cingulata*. The *V. ammodytes* caught by Clark (1967) died within an hour of capture. The dead individual found by Arsovski et al. (2014) had the centipede's head protruding from the lower abdomen suggesting that the gut had either burst due to the pressure or that the live centipede had broken out of the snake's body cavity. The report by Tan & Kretzschmar (2009) is of an adult *V. ammodytes* being "paralyzed" mid-ingestion of an adult *S. cingulata*, suggested to be a case of envenoming by the prey. After 10 minutes, the snake was prodded using a stick after which it expelled the dead prey; it is therefore unclear whether the snake would have continued to ingest the centipede if it had not been disturbed.

Scolopendra centipedes are robust and hard to kill (personal observation). The three recorded accounts of them being predated on by *V. ammodytes* (Clark, 1967; Tan & Kretzschmar, 2009; Arsovski et al., 2014) alongside the record herein, suggest that the venom of *V. ammodytes* is sufficiently potent to subdue and ingest *S. cingulata*. Some members of the closely related Pelias group of vipers are known to be entomophagous with greater venom toxicity towards crickets (e.g. *V. lotievi* and *V. ursinii*; Starkov et al., 2007). A study by Lang Balija et al. (2020) compared the venom of the entomophagous *V. ursinii* with that of *V. ammodytes*, and found *V. ammodytes* venom to be significantly more toxic to mice than crickets (114-fold higher mass-normalized LD50), when compared to the venom of *V. ursinii* (5-fold higher mass-normalised LD50). This suggests that *V. ammodytes* has no significant dietary-related specialised toxicity towards arthropods (Lang Balija et al., 2020) but the study did not take in to account the possibility that the venom of the juvenile vipers could be more toxic to insects than that of older vipers. The protein composition of *V. ammodytes* venom is known to change with age (Arikan et al., 2014) and in other Viperidae this change has indicated the presence of prey-specific toxins that parallel changes in dietary preferences (e.g. Zelanis et al., 2008). Further research is required to determine whether this is also the case in *V. ammodytes*.

The observations described here further support the general diet of the iconic nose-horned viper and confirm the ability for small individuals to successfully subdue and ingest arthropods of significant size.

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REFERENCES

Arikan, H., Göçmen, B., İğci, N. & Akman, B. (2014). Age-dependent variations in the venom proteins of *Vipera kaznakovi* Nikolsky, 1909 and *Vipera ammodytes* (Linnaeus, 1758)(Ophidia: Viperidae). *Turkish Journal of Zoology* 38: 216-221.

Arnold, N. & Ovenden, D. (2004). *Collins Field Guide to the Reptiles and Amphibians of Britain and Europe*. London, Harper Collins, 272 pp.

Arsovski, D., Ajtić, R., Golubović, A., Trajčeska, I., Đorđević, S., Anđelković, M., Bonnet, X. & Tomović, L. (2014). Two fangs good, a hundred legs better: juvenile viper devoured by an adult centipede it had ingested. *Ecologica Montenegrina* 1: 6-8.

Biella, H. J. (1983). *Die Sandotter*. Wittenberg Lutherstadt, Die Neue Brehm-Bücherei, A. Ziemsen, 84 pp.

Clark, R. J. (1967). Centipede in stomach of young *Vipera ammodytes meridionalis*. *Copeia* 1967: 224-224.

Dugon, M. M. & Arthur, W. (2012). Prey orientation and the role of venom availability in the predatory behaviour of the centipede *Scolopendra subspinipes* mutilans (Arthropoda: Chilopoda). *Journal of Insect Physiology* 58: 874-880.

Frangides, C. Y., Koulouras, V., Kouni, S. N., Tzortzatos, G. V., Nikolaou, A., Pneumaticos, J., Pierrakeas, C., Niarchos, C., Kounis, N. G. & Koutsojannis, C. M. (2006). Snake venom poisoning in Greece. Experiences with 147 cases. *European Journal of Internal Medicine* 17: 24-27.

Heckes, U., Gruber, H. J. & Stümpel, N. (2005). *Vipera (Vipera) ammodytes* (Linnaeus, 1758) - Hornotter, Sandviper. In Joger, U. & Stümpel, N. (Ed.), *Handbuch der Reptilien und Amphibien Europas, 3/IIB Schlangen (Serpentes) III Viperidae*. Wiesbaden, Aula Verlag, 81-150.

Lang Balija, M., Leonardi, A., Brgles, M., Sviben, D., Kurtović, T., Halassy, B. & Križaj, I. (2020). Biological activities and proteomic profile of the venom of *Vipera ursinii* ssp., a very rare karst viper from Croatia. *Toxins* 12: 187.

Latinović, Z., Leonardi, A., Šribar, J., Sajevic, T., Žužek, M. C., Frangež, R., Halassy, B., Trampuš-Bakija, A., Pungerčar, J. & Križaj, I. (2016). Venomics of *Vipera berus berus* to explain differences in pathology elicited by *Vipera ammodytes ammodytes* envenomation: Therapeutic implications.

Journal of Proteomics 146: 34-47.

Luiselli, L. (1996). Food habits of an alpine population of the sand viper (*Vipera ammodytes*). *Journal of Herpetology* 30: 92-94.

Starkov, V. G., Osipov, A. V. & Utkin, Y. N. (2007). Toxicity of venoms from vipers of *Pelias* group to crickets *Gryllus assimilis* and its relation to snake entomophagy. *Toxicon* 49: 995-1001.

Stille, B. & Stille, M. (2017). *The Herpetofauna of Corfu and Adjacent Islands*. Frankfurt am Main: Edition Chimaira, 354 pp.

Tan, K. & Kretzschmar, H. (2009). On a meeting between the horn viper and a centipede in the Peloponnese, Southern Greece or the biter, bit. *Advanced Science Letters* 2: 10-13.

Zelanis, A., Travaglia-Cardoso, S. R. & Furtado, M. D. F. D. (2008). Ontogenetic changes in the venom of *Bothrops insularis* (Serpentes: Viperidae) and its biological implication. *South American Journal of Herpetology* 3: 43-50.

Zimić, A. & Jelić, D. (2014). Interspecific illusions: Underestimation of the power of the Mediterranean banded centipede. *Hyla* 2014: 27-29.

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