



Further Insights on the Nocturnal Activity of the Nose-horned Viper *Vipera ammodytes* (Linnaeus, 1758) (Reptilia: Viperidae) in Bulgaria: First Observation in October

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Abstract: Crepuscular and nocturnal activity of *Vipera ammodytes* has been documented between the beginning of April and the first half of September, with most observations being made during summer. However, nocturnal surveys are conducted predominantly in the warm summer months, which might obscure the true patterns of the species' nocturnal activity. We here present the first report of nocturnal activity of *V. ammodytes* in mid-autumn. A neonate female viper was found to be active at 21:10 h in calm cloudless weather on 3 October 2020 in southwestern Bulgaria, following a hot day. The viper's body temperature and the microhabitat temperature were 21.6 °C and 18.9 °C, respectively. The moon phase was shortly after a full moon and lunar illumination was 97 %. This observation brings further insight on the nocturnal activity of the species and provides a basis for further research.

Key words: night, snakes, feeding, temperatures, moonlight

Introduction

Crepuscular and nocturnal activity of the Nose-horned viper *Vipera ammodytes* (Linnaeus, 1758) are not uncommon in Bulgaria (BESHKOV 1993, DYUGMEDZHIEV et al. 2020a), as well as in other parts of the species' range (SCHREIBER 1912, BOULENGER 1913, CALINESCU 1926, cited in BESHKOV 1993, KARAMAN 1939, BRUNO 1967, MUSCHELISCHVILI 1970, BANNIKOV et al. 1971, BIELLA 1983, ZADRAVEC & KOREN 2017). These activities are usually observed in the warmest parts of the year. In Bulgaria, crepuscular activity has been documented between the beginning of April and the first half of September and nocturnal activity was observed between the beginning of June and the first half of September (DYUGMEDZHIEV et al. 2020a). However, nocturnal surveys on snakes in Bulgaria are car-

ried out mainly during the warm summer months, which might lead to a sampling bias in the information on the true patterns of nocturnal activity of the species. Recently, an interesting observation of nocturnal activity of *V. ammodytes* during the first half of April was reported from Croatia (ZADRAVEC & KOREN 2017). Here we present, to our knowledge, the first record of nocturnal activity of *V. ammodytes* in October.

Materials and Methods

A two-day field visit combining both diurnal and night searches was conducted in southwestern Bulgaria on 3–4 October 2020 along the Struma River, between Kresna Gorge and Rupite area. This visit was part of an ongoing study of *Vipera ammodytes* in Bulgaria. The area falls into the conti-

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nenal-Mediterranean zone (KOPRALEV 2002). For more details on the study sites and field effort, see DYUGMEDZHIEV et al. (2020b) and ANDONOV et al. (2020). Captured vipers were measured, i.e. snout to vent length (SVL) and tail length (TL), precision 0.5 cm, and weighted (W, precision 0.01 g). Immediately after capture, the snakes' body (cloacal) temperature, the substrate- and air temperatures at 15-20 cm above the ground were measured with a quick-reading thermometer (TOPELEK TECP022AH, precision 0.3 °C). The microhabitat temperature was estimated by the average of the substrate- and air temperature. After all measurements were taken, captured vipers were released on site. Moonrise, moon phase and % illumination were obtained with Virtual Moon Atlas (v. 7.0). Coordinates were taken with hand held GPS device (Garmin eTrex 20, accuracy ± 5 m).

Results

On 3 October 2020 a neonate female *Vipera ammodytes* (SVL = 18 cm, TL = 2.4 cm, W = 5.53 g) was found active on the surface at 21:10 h (approximately two hours after sunset; day length: 11 h 38 min) on the gravel of the railway line in Kresna Gorge (N41.770°; E23.156°; 223 m a.s.l.) (Fig.1). The viper's body temperature was 21.6 °C and the microhabitat temperature 18.9 °C. The weather was calm, without wind and with clear sky. Moonrise was approximately one hour before the time of observation. The moon was at two days after the full-moon phase and moon illumination at time of observation was high – 97 %. However, the use of an artificial lighting was needed for clear and detailed vision. The weather during the day, as well as on the following day was hot, with maximal daily temperatures above 28 °C. Two adult male *V. ammodytes* were found active during the diurnal searches (one in each day), as well as several colubrid species, such as *Dolichophis caspius* (Gmelin, 1789) and *Elaphe quatuorlineata* Lacépède, 1789. On the evening of 3 October, we also observed an active subadult *Tellescopus fallax* Fleischmann, 1831, approximately an hour before the observation of the neonate *V. ammodytes*.

Discussion

Vipera ammodytes is found active, both during the day as well as at night, at ambient temperatures between 9-10 and 34-35 °C (BRUNO 1967, BIELLA 1983, GHIRA 2016, ZADRAVEC & KOREN 2017, DYUGMEDZHIEV et al. 2020a, DYUGMEDZHIEV et al.

2021) and body temperatures between 14 and 35-36 °C (ZADRAVEC & KOREN 2017, DYUGMEDZHIEV et al. 2020a, DYUGMEDZHIEV et al. 2021). Nocturnal activity is observed following hot as well as medium warm days (DYUGMEDZHIEV et al. 2020a). The high temperatures observed during the first half of October in Bulgaria in 2020, seem to allow nocturnal activity at least at the first few hours of the night. These unusually high temperatures for this time of year might be due to the complex climate changes, which are pressuring towards a steady warming of the planet in the last decades. These changes are known to cause shifts in activity patterns in many species (HUT et al. 2012, LEVY et al. 2019). It might be speculated that with further increase of temperatures, observations of reptiles' nocturnal activity in mid- and late autumn might become more common. Additionally, there is a clear bias in search effort on snakes' nocturnal activity, because surveys, at least in Bulgaria, are usually done during the warmest months, which might obscure the true patterns of the species' nocturnal activity. Vipers are often difficult to find especially at night, however increased and systematic search effort leads to increase in observations (DYUGMEDZHIEV et al. 2020a). Therefore, the nocturnal activity of *V. ammodytes* in mid- and late autumn might in fact be underestimated. Further studies are needed to confirm these statements.

Moonlight illumination probably also affects the nocturnal activity of the species, since most nocturnal observations from Bulgaria are either in close-to-full moon phases or no moonlight at all (DYUGMEDZHIEV et al. 2020a). Indeed, during the here reported observation, the moon was also in close-to-full moon stage. The fact that adults were found only during the day and the only observed nocturnally active specimen during this period was a neonate, born a few months earlier, might be of particular interest. In the period between their birth (which is usually from the second half of August to the first half of September (LUISELLI & ZUFFI 2002, DYUGMEDZHIEV 2020) and their first hibernation, neonates need to feed more intensively, in order to obtain a sufficient amount of reserves, allowing for a successful hibernation (ALTWEGG et al. 2005, DYUGMEDZHIEV 2020). Thus, by prolonging their activity with staying active at night in mid-autumn, some neonate individuals may increase their feeding opportunities. However, since sufficient surveys of snakes' nocturnal activity in mid- and late autumn are lacking, this hypothesis should be tested further.



Fig. 1. The nocturnally active neonate female *Vipera ammodytes* observed on 3 October 2020 and the habitat where it was found (small picture).

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