A case of unusual head scalation in *Vipera ammodytes* (Squamata: Serpentes: Viperidae) in Western Serbia

In squamates, head scalation is often used in taxonomic identification of a species (Ursel 1978; Sanders et al. 2006), as the genes which determine the developmental processes related to scalation could change through the speciation (Murphy et al. 1987 and references therein). Some studies have suggested that the scalation pattern could have genetic (Murphy et al. 1987; King 1997), environmental (Lourdais et al. 2004), or combined background (Uveges et al. 2012). It is therefore important to report any deviation from the "typical" head scalation pattern in a squamate species, as it can be relevant for different evolutionary and ecological studies. Furthermore, some studies suggested that inbreeding (Murphy et al. 1987; Olsson et al. 1996) or abiotic factors such as temperature (Shine et al. 2005; Idrisova 2018) could contribute to the morphological abnormalities such as unusual scalation pattern. Sometimes, such malformations could indicate the need for future conservation assessments or actions on particular population(s) as some malformations can be correlated with the ecological performance of the individual (Brown et al. 2017). Here we report a case of atypical head scalation in a nose-horned viper (*Vipera ammodytes*), as we did not detect it in this species in more than thirty years of field work.

Vipera ammodytes (Linnaeus, 1758) is venomous snake with a distribution range that spans from southern Austria and northern Italy, through the Balkans to Asia Minor (Crnobrnja-Isailović & Haxhiu 1997). It is one of the larger European vipers, with the total body length usually up to 1 m (Arnold & Ovenden 2002). The head is large, triangular, with its dorsal side covered by small scales, except for the supraoculars (Arnold & Ovenden 2002). Within its range, the species is easily recognizable by the prominent horn on the top of the viper's snout. It has 21-23 rows (sometimes 19) of dorsal scales on the mid body and 137-163 ventral scales (Tomović 2006; Boulenger 1913). There is a sexual dimorphism which is the most prominent in the tail length and

number of subcaudal scales (males have longer tail and more subcaudal scales) (Tomović 2002).

During a survey carried out on October 11th 2018 in western Serbia, we encountered a juvenile nose-horned viper (total length L =248 mm) which had large dorsal head scales on the central part of the head, besides the normal large supraoculars and other small scales (Fig.1). The large scales could be considered as one scale incompletely separated or as two large scales with the smaller one in between (Fig.1). We did not record any other unusual morphological trait on this viper. The individual had 2 supraoculars, 12 small scales surrounding the eyes, 6 midorbitals, 1 suprarostral and the eyes were separated with two rows of scales from the supralabials. The head length was 17,98 mm, the head width was 11,74 mm, the rostral height was 2,06 mm, the rostral width was 2,00 mm and the horn height was 3,60 mm. All these measurements of morphometric characters are within the usual range of values previously published for *V. ammodytes* (for example see Tomović 2006; Tok & Kumluts 1996). The snake's behaviour was the same as in other encountered nose-horned vipers. All the examinations were done *in situ* and the animal was marked and released afterwards. In the same local population, this viper was the only one among the 18 measured individuals which had large head scales. Fig. 2 represents a typical head scalation in *V. ammodytes* from the same local population. Furthermore, the observed juvenile individual was the only one with this type of head scalation among 74 examined nose-horned vipers in the year of 2018 in Serbia. To the best of our knowledge, this type of head scalation in *V. ammodytes* has never been reported. Regarding other snake species, authors have reported a fragmentation of head scales (for example: Stoyanov & Tzankov 2017 for *V. berus*; Brown et al. 2017 for *Stegonotus cucullatus*).

The presence of large scales on the dorsal side of the head of the nose-horned viper reported individual could be explained from several points of view: Ursel (1978) proposed that presence of small scales on the dorsal side of the viperid snakes head is the result of the fragmentation of large scales into smaller ones, which happened secondary in the course of evolution. If true, then this atypical scalation could be the case of simple atavism. In their study on *V. aspis*, Lorioux et al. (2013), concluded that the formation of head scales happens during late embryogenesis and it can be influenced by temperature. So, the presence of large head scales could also be the result of environmental impact on the embryogenesis of this individual. Murphy et al. (1987) concluded that snakes scalation abnormalities could be either determined by the polygenes or by a large influence of the genetic background against which a mutant gene is expressed, implying that scalation abnormalities in *Crotalus atrox,* which they observed, could be the result of inbreeding. Based on our interviews with the local inhabitants, some years ago, the vipers were deliberately killed in large numbers during the mating season in the area where the reported juvenile nose-horned viper individual was found. Also, the habitat where the reported individual was found, is intersected with roads and agricultural land. Having this in mind, the presence of large scales on the head could also be the result of inbreeding in the small, disturbed population. Brown et al. (2017) found that both genetic and environmental factors influence

Figure 1. Nose-horned viper with large head scales.

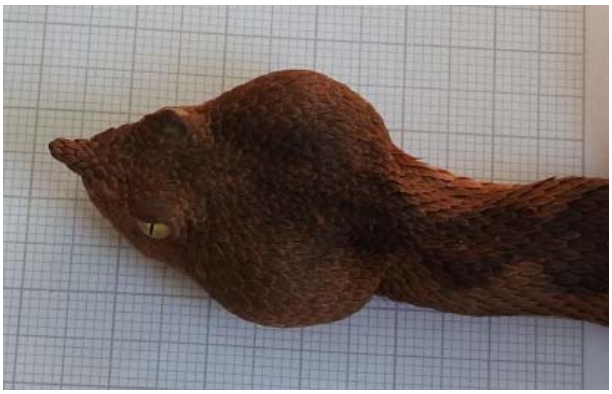

Figure 2. Nose-horned viper with typical head scalation.

early embryogenesis and produce head scale abnormalities in *S. cucullatus*, and they correlated those abnormalities with the ecological performance of the individuals. Other than this, Brown et al. (2017) have also found that scale abnormalities are not limited to small isolated, disturbed populations.

Furthermore, considering that the reported nose-horned viper is a juvenile individual, maybe postnatal changes in scalation can happen as reported for *V. ursinii* (Tomović et al. 2008). However, this possibility has to be taken with caution as recent results of Bauwens et al. (2018) study confirmed ontogenetic stability of individual head scalation pattern in a large population of *V. berus*.

In conclusion, this unusual head scalation in *V. ammodytes* can be considered very rare as it was not previously published elsewhere. To answer the question whether the cause is genetic, environmental or combined, more evidence and further studies (both genetic and ecological) are needed.

Acknowledgements. The fieldwork was kindly funded by The Rufford Foundation (grants no: 19578-1 and 23392-2) for TČ and by Ministry of Education, Science and Technological Development of Republic of Serbia (grant no 173025), for both JCI and TČ. TČ is very grateful to Nikola Vuletić for logistic help.

References

Arnold, E.N., Ovenden, D., Burton, J. A. (2002): Reptiles and amphibians of Britain and Europe. Collins, London.

Bauwens, D., Claus, K., Mergeay, J. (2018): Genotyping validates photo-identification by the head scale pattern in a large population of the European adder (*Vipera berus*). Ecology and Evolution 8(5): 2985-2992.

Boulenger, G.A. (1913): On the geographical races of *Vipera ammodytes*. Journal of Natural History 11(63): 283-287.

Brown, G.P., Madsen, T., Dubey, S., Shine, R. (2017): The causes and ecological correlates of head scale asymmetry and fragmentation in a tropical snake. Scientific reports 7(1): 11363.

Crnobrnja-Isailović, J., Haxhiu, I. (1997): *Vipera ammodytes*. pp. 384-385. In: Gasc, J.P. et al. (eds.), Atlas of Amphibians and Reptiles in Europe. Societas Europaea Herpetologica and Muséum National d' Histoire Naturelle, Paris.

Idrisova, L.A. (2018): The Effect of Incubation Temperature on Deviations of Pholidosis and Malformations in Grass Snake *Natrix natrix* (L. 1758) and Sand Lizard *Lacerta agilis* (L. 1758). KnE Life Sciences 4(3): 70-74.

King, R.B. (1997): Variation in brown snake (*Storeria dekayi*) morphology and scalation: sex, family, and microgeographic differences. Journal of Herpetology, 31(3): 335-346.

Lorioux, S., Vaugoyeau, M., DeNardo, D.F., Clobert, J., Guillon, M., Lourdais, O. (2013): Stage dependence of phenotypical and phenological maternal effects: insight into squamate reptile reproductive strategies. The American Naturalist 182(2): 223-233.

Lourdais, O., Shine, R., Bonnet, X., Guillon, M., Naulleau, G. (2004): Climate affects embryonic development in a viviparous snake, *Vipera aspis*. Oikos 104: 551-560.

Murphy, J.B., Rehg, J.E., Maderson, P.F., McCrady, W.B. (1987): Scutellation and pigmentation defects in a laboratory colony of Western diamondback rattlesnakes (*Crotalus atrox*): mode of inheritance. Herpetologica 43(3): 292-300.

Olsson, M., Gullberg, A., Tegelström, H. (1996): Malformed offspring, sibling matings, and selection against inbreeding in the sand lizard (*Lacerta agilis*). Journal of Evolutionary Biology 9(2): 229-242.

Sanders, K.L., Malhotra, A., Thorpe, R.S. (2006): Combining molecular, morphological and ecological data to infer species boundaries in a cryptic tropical pit viper. Biological Journal of the Linnean Society 87: 343-364.

Shine, R., Langkilde, T., Wall, M., Mason, R. T. (2005): The fitness correlates of scalation asymmetry in garter snakes *Thamnophis sirtalis parietalis*. Functional Ecology 19(2): 306-314.

Stoyanov, A., Tzankov, N. (2017): Individual variation of pileus scalation characteristics in *Vipera berus bosniensis* Boettger, 1889 (Reptilia: Sqaumata: Viperidae). North-Western Journal of Zoology 13(1): 186-191.

Tomović, L., Radojičić, J., Dzukić, G., Kalezić, M.L. (2002): Sexual dimorphism of the sand viper (*Vipera ammodytes* L.) from the central part of Balkan Peninsula. Russian journal of herpetology 9(1): 69-76.

Tomović, Lj. (2006): Systematics of the nose-horned viper (*Vipera ammodytes*, Linnaeus, 1758). The Herpetological Journal 16(2): 191-201.

Tomović, L., Carretero, M.A., Ajtic, R., Crnobrnja-Isailovic, J. (2008): Evidence for post-natal instability of head scalation in the meadow viper (*Vipera ursinii*) – patterns and taxonomic implications. Amphibia-Reptilia 29(1): 61-70.

Tok, C.V., Kumluţş, Y. (1996): On *Vipera ammodytes transcaucasiana* (Viperidae) from Perşembe, Black Sea region of Turkey. Zoology in the Middle East 13(1): 47-50.

Ursel, F. (1978): Der Pileus der Squamata. Stuttgarter Beiträge zur Naturkunde Serie A

Üveges, B., Halpern, B., Péchy, T., Posta, J., Komlósi, I. (2012): Characteristics and heritability analysis of head scales of the Hungarian meadow viper (*Vipera ursinii rakosiensis*, Méhely 1893). Amphibia-Reptilia 33(3-4): 393-400.

Key words: head scales, scale oligomerization, *Vipera ammodytes*, viper, Serbia.

Article No.: e197505
Received: 02. February 2019 / Accepted: 04. September 2019
Available online: 10. September 2019 / Printed: December 2019

Tijana ČUBRIĆ[1] and Jelka CRNOBRNJA-ISAILOVIĆ[1,2]

1. Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, Višegradska 33, 18 000 Niš, Serbia.
2. Department of Evolutionary Biology, Institute for Biological Research "Siniša Stanković", University of Belgrade, Despota Stefana 142, 11000 Belgrade, Serbia.

* Corresponding author, T. Čubrić, E-mail: tijana.cubric@pmf.edu.rs