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Malformation of eye pupil in nose-horned viper (*Vipera ammodytes*) from a wild population

Tijana Čubrić[1,*] and Jelka Crnobrnja-Isailović[1,2]

Knowing which diseases occur in natural populations is very important for conservation biology because they may reduce survival and breeding output. Even though parasites require a threshold host population size to persist, there are examples in which parasites can cause host population extinctions, such as when the parasite can persist in alternative hosts or environmental reservoirs (de Castro and Bolker, 2005). Even if in the absence of such alternatives, the parasites can reduce population size and, coupled with demographic stochasticity, can contribute to extinctions (de Castro and Bolker, 2005). Also, if habitat is fragmented there is limited source of food which leads to weaker immune system of animals and they are more vulnerable to infestation. Besides diseases, any morphological malformation on animals from wild population should be noted as it contributes to the understanding of the biology and ecology of species, which play a crucial role in planning conservation actions.

The nose-horned viper, *Vipera ammodytes* (Linnaeus, 1758), and its counterparts from the family Viperidae (Reptilia: Squamata: Serpentes) have vertical pupil that, by producing a sharper image onto the retina in the horizontal plane, increases visual acuity by day, which is important for ambush predators (Brischoux et al., 2010). Moreover, vertical pupil affords finer control over light (by pupil dilatation) both in dim and bright light conditions. In this regard, we could presume that any fail in viper's ability to adjust optimal quantity of received sunlight eventually leads to decrease in fitness of the individual. Therefore, we considered the occurrence of pupil malformation in a wild nose-horned viper worth pointing out, as we did not detect one in more than thirty years of field work.

During a survey carried out on October 2nd 2016 at the base of Goč Mountain in Central Serbia, we encountered a male of *V. ammodytes* (total length L = 360 mm) who displayed a malformation of the pupil of the right eye (Fig. 1). The pupil had unusual widen rectangle shape. The snake could not shift this pupil to vertical slit, which normally happens in this species when it moves from dim to bright light conditions. The left eye pupil was of usual shape. There were no other malformations on snake's body. Cloacal temperature was 26.6 °C (range of cloacal temperatures in our sample, n=47, varied from 18.3–32.8 °C). The snake's behaviour was the same as in other encountered nose-horned vipers. This individual was moving through the habitat - a rocky slope with some bushes near the mountain stream and railroad. We measured and marked the viper and then released it back at the place of capture.

Body Condition Index (BCI) of the individual with the malformed eye was calculated using methodology applied in calculating the BCI for *Vipera aspis* (Aubret et al., 2002). For comparison, the same index was calculated also for other specimens from Serbia collected by us in the same year, taking into account their age/sex status. Individuals were categorized into separate groups as adult males (AM, minimal snout to vent length, SVL = 300 mm), adult females (AF, minimal SVL = 300 mm), and juveniles (JU, SVL up to 300 mm). Their total length (TL) and SVL were measured with a plastic rope (1 mm precision) and body mass was measured by Pesola scale. The BCI of each individual was calculated as the residual score from the general linear regression of ln-transformed body mass against ln-transformed SVL. All analyses were done in Statistica 7.0 (StatSoftInc.).

The reported individual was the only one with eye malformation among 47 nose-horned vipers (2.1%) that

[1] Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia

[2] Institute for Biological Research "Siniša Stanković", University of Belgrade, Despota Stefana 142, 11000 Belgrade, Serbia

* Corresponding author e-mail: tijanacubric@hotmail.com

Figure 1. Malformation of a pupil in the right-side eye of *Vipera ammodytes* (photo by T. Čubrić).

we examined this year from Serbia. However, it had positive BCI value (it was above the regression line) in our sample of adult males. According to the applied method, a snake that weighs more than predicted for its length will have a positive residual and can be evaluated as in a relatively good condition (Waye and Mason, 2008).

This uncommon condition detected in the wild viper *in situ* could be the consequence of infection (in snakes, direct communication between the mouth and subspectacular space (space beneath spectacle) may allow ascending infections, see in Mags et al., 2008) or specific ocular trauma. However, literature data about ocular diseases in snakes are very obscure. Namely, 58% of publications (collected via Google Scholar) were from veterinary science, 31% were from human medicine (dealing with cases of ocular complications in humans after snake bite) and only 11% were biological studies (published in biology journals). The majority of the analyzed publications (54%) described ocular diseases and treatment of snakes, which were kept in captivity. Common ocular diseases in snakes included, among others, retained spectacles, subspectacular abscesses and pseudobuphthalmos (infection of the subspectacular space) , spectaculitis (inflammation of the spectacle) (Mags et al., 2008, Da Silva et al.,2015), fungal infections (Allender et al., 2011), trauma, cataracts; exophthalmos (periorbital swelling), congenital defects, neoplasia (Hausmann et al., 2013), anophthalmia (absence of one or both eyes) (Jablonski and Mikulíček, 2015) and buphthalmos (enlargement of the eye ball) (Sant'Anna et al., 2013). As there was no evidence of dermatitis in the examined individual, the observed malformation may be a result of synechia, which is an eye condition where the iris adheres to cornea or lens, and often is the consequence of inflammation. Symptoms include changed pupil shape and could lead to glaucoma. This could happen to viper examined in this study due to some ocular trauma.

In summary, there is a paucity of published information on eye conditions, including ocular malformations and diseases in wild populations of snakes, especially

among vipers. So far, we did not detect any published information on ocular malformation or disease in *Vipera ammodytes*, either on individuals held in captivity or in those from the wilderness. Therefore, we could conclude that this condition is either extremely rare or so far was not recognized as worth reporting. Additionally, in snakes, this condition could lead either to a fast decline of the individual fitness and consequent death or to a quick recovery which could explain the lack of information on this topic. Collecting information on morphological malformations in animals from wild populations is undoubtedly important for the development of efficient conservation actions.

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