

Head-scale instability and the apparent heritability of a head scale anomaly in the northern viper (*Vipera berus*)

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INTRODUCTION

The northern viper or adder (*Vipera berus*) is increasingly the subject of conservation projects. The data collected by such projects can be subject to much deeper analysis if they are collected from known individuals. Individual recognition can be achieved by marking adders (scale clipping, paint spots, etc.) but this involves varying degrees of disturbance. This disturbance can be avoided if the adder's natural markings are exploited, in particular, the number and arrangement of head-scales (Benson, 1999) provide a natural 'fingerprint' and head and neck markings (Sheldon & Bradley, 1989) are distinctive. Other unusual features such as healed injuries or scale anomalies can facilitate quick and easy recognition. Since the advent of digital photography and easy access to computers, the cataloguing and retrieval of images showing head-scale patterns and other features have become relatively easy. In addition, 'photo-id' image analysis software is available to aid comparison between 'unknown' adder photos and images in a project archive (see <http://www.conservaionresearch.co.uk/adders/adders.htm>).

Individual recognition by the use of head-scale patterns relies on the assumption that such patterns are stable during the life time of the individual. In general, it is believed that reptile scales and scale hinges are differentiated during embryonic development and that any post-natal alterations to the size, shape and distribution of scales are a result of injury (Maderson, 1965). If there are natural injuries and abrasions to scales then the healed scales are never regular and there is no restoration of their geometric pattern (Maderson et al., 1978).

Within the frame of the Kent Reptile and Amphibian Group's 'Adders in Decline Project', there have been detailed investigations of adder populations on the North Downs since 2004. From the start these involved individual adder recognition from photographs of head-scales and neck markings. The project archive to date holds head-scale pattern records for 594 individuals, of which 78% have been observed more than once and of the 172 adults, 34 were known from when they were immature. Two interesting observations on head-scales came to light in 2014 and are documented here.

OBSERVATIONS

Scale instability

Until recently the only changes in head-scale patterns

detected between successive observations had been those resulting from obvious injury (or possibly disease). In 2014, observation of a sub-adult male (SM44) indicated that scale numbers may increase by sub-division of scales (technically termed 'polymerisation'). SM44 was born in 2012 and from then until the end of 2014 has been seen on 15 occasions. It is an unusual specimen as towards the end of 2014 it adopted a silver-grey colouring, unlike the fawn colour of its peers, suggesting the onset of sexual maturity despite being only at the end of its second full year of life. Sexual maturity would normally be expected during the third full year of life (Prestit, 1971). However, close to the time of hibernation it returned to a more normal fawn colouration. On the 30th August, SM44 had only three paraocular scales on the left hand side (Fig. 1a). By the 15th September the second scale in the row appeared to be partially sub-divided (Fig. 1b). By the 16th October the second scale was completely divided into two smooth-edged scales of normal appearance, i.e. no appearance of injury, so that the number of scales in the row increased from three to four (Fig. 1c).

This is not the first occasion that head-scale instability has been reported. Observations on the meadow viper (*V. ursinii macrops*) in Montenegro over a period of four years revealed considerable changes in head-scale patterns; 12 out of 23 specimens (52.2%) that were seen more than once had quite distinct changes (Tomovi et al., 2008) and these occurred in adult males and females as well as immatures. The observations were very detailed but no explanation was offered as to why the scale patterns had changed. A more recently published study, on the head-scales of a different sub-species (*V. ursinii rakosiensis*) in Hungary (Üveges et al., 2012), appears to contradict these findings as observations from 2004 to 2012 gave no evidence of any post-natal instability of head-scales. Since this is a little known phenomenon it would appear to occur under unusual circumstances.

To date, our observations on the North Downs populations of adders suggests that although new head-scales can be created quickly (<2 months) this occurs rarely. It is therefore unlikely to result in any significant inaccuracy in our biological investigations, especially when other indicators such as neck markings are also taken into account in individual recognition. Nevertheless scale instability remains an interesting and unexplained phenomenon.

Inherited scale anomaly

A female adder (F1), known as an adult since 2006 and seen on

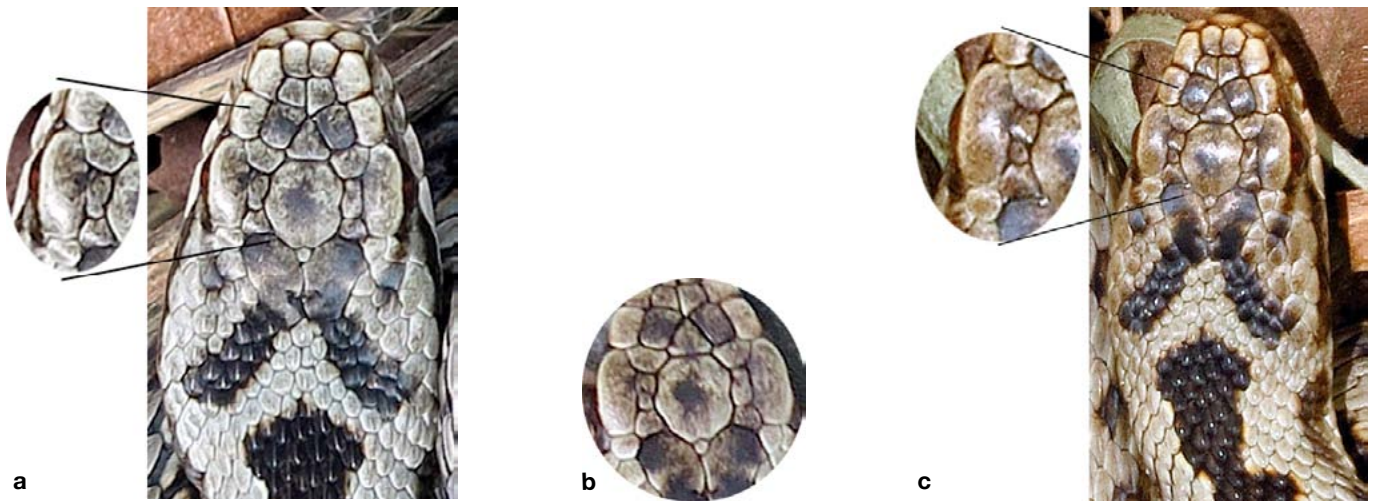


Figure 1. A change in the number of paraocular scales on the left hand side of sub-adult male (SM44) *V. berus* in the period 30th August to 16th October 2014, **a.** 30/8/14 - SM44 showing 3 paraocular scales, **b.** 15/9/14 - SM44 with 2nd paraocular scale partially subdivided, **c.** 16/10/14 , SM44 with four smoothly edged paraocular scales.

61 occasions, is very unusual in having a slit-like fold into the anterior portion of her frontal scale (Fig. 2a). She gave birth in August 2014 and four of the young that were found displayed the same character to some degree; the example shown in Fig. 2b is the most pronounced, i.e. in the others the slit was shorter. As a large mature female she would most likely have given birth to more than four young; these were not observed (or perhaps not recognised as her young) and so it remains



Figure 2. Scale anomaly, a slit in the anterior portion of the frontal scale (indicated by arrows) found in both a female adder and some of her brood, **a.** Adult female (F1) showing a slit in the anterior portion of the frontal scale, **b.** Neonate from the brood of female F1 showing a similar slit

unknown whether any others also displayed the same anomaly. The scale anomaly would appear to have been inherited from the mother. Until 2014, the anomaly was unique to F1, which is surprising since from 2006 to the present she may have produced as many as five litters; biennial reproduction is normal for female adders (Prestt, 1971). Her offspring are likely to have been included in the observations of our monitoring programme but prior to 2014 none showed the frontal slit. This suggests that the anomaly may be a genetically recessive trait and may have been expressed only as a result of mating with one of her own male offspring; something that may not have happened in

previous years. Female adders often engage in multiple mating and broods may be sired by several males (Ursenbacher et al., 2009), this is likely to be the case with F1 as she was observed to mate with at least two males in April 2014. Consequently, not all offspring would necessarily show the anomaly.

The presence of this scale marker may help to assign maternity and location of birth in adders found in later years if, from the size of an individual, it is possible to estimate its year of birth as being 2014.

REFERENCES

- Benson, P.A. (1999). Identifying individual adders, *Vipera berus*, within an isolated colony in East Yorkshire. *The Herpetological Bulletin* 67: 21-27.
- Maderson, P.F.A. (1965). The embryonic development of the squamate integument. *Acta Zoologica* 46: 275-295.
- Maderson, P.F.A., Baranowitz, S. & Roth, S.I. (1978). A histological study of the long term response to trauma of the squamate integument. *Journal of Morphology* 157: 121-135.
- Prestt, I. (1971). An ecological study of the viper *Vipera berus* in Britain. *Journal of Zoology, London* 164: 373-418.
- Sheldon, S. & Bradley, C. (1989). Identification of individual adders (*Vipera berus*) by their head markings. *The Herpetological Journal* 1: 392 – 395.
- Tomović, L., Carretero, M.A., Ajtić, R. & Crnobrnja-Isailović, J. (2008). Evidence for post-natal instability of head scalation in the meadow viper (*Vipera ursinii*) - patterns and taxonomic implications. *Amphibia-Reptilia* 29: 61-70.
- Ursenbacher, S., Erny, C. & Fumagalli, L. (2009). Male reproductive success and multiple paternity in the wild, low-density populations of the adder (*Vipera berus*). *Journal of Heredity* 100: 365-370.
- Üveges, B., Halpern, B., Péchy, T., Posta, J. & Komlósi, I. (2012). Characteristics and heritability analysis of the head-scales of the Hungarian meadow viper (*Vipera ursinii rakosiensis*, Méhely 1893). *Amphibia-Reptilia* 33: 393-400.