Photographic identification of individual Barred Grass Snakes *Natrix helvetica*[1]

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Summary

Photographic identification allows recognition of individual animals, which is useful in ecological and behavioural studies. This note documents the stability of patterns from hatchling to adult in Barred Grass Snakes *Natrix helvetica*. Variation in the dark markings within the first fifteen or sixteen anterior ventral scales was sufficient to allow discrimination between more than 700 individuals. Subtle changes in the extent of dark markings were noted within very few cases; in one snake the markings decreased in extent and in a relatively elderly individual marking definition decreased. Nevertheless, neither of these changes was sufficient to create uncertainty in recognising individuals on recapture, and for practical purposes the ventral markings were constant through adult life. Such markings are highly reliable for use in population monitoring of Barred Grass Snakes.

Introduction

'Individual recognition of amphibians and reptiles by means of natural markings has been widely used in ecological studies (e.g. Baker & Gent 1998; Ferner 2007; Sacchi *et al*. 2016). Perhaps the earliest use was described by Carlström & Edelstam (1946) in studies of the Common Grass Snake *Natrix natrix*. They photographed ventral scales and found that the black and white markings varied between individuals but over time remained 'unchanged after a considerable increase in size'. Recording the pattern on ventral scales by sketch, photograph or photocopy has been widely used in field studies of *Natrix natrix* and *Natrix helvetica* (e.g. Mertens 1995; Madsen 1983; Gregory 2004; Sewell *et al*. 2015) but with little detail of the methodology itself.

The current work reports observations made during the course of monitoring two large populations of Barred Grass Snakes *Natrix helvetica* in Norfolk. One of these is at a confidential location where Pool Frogs *Pelophylax lessonae* were reintroduced to England (Foster *et al.* 2018). It was monitored as part of the reintroduction programme from 2004 to 2013 and independently from 2014 to 2019 (see Sewell *et al*. 2015). The second site is a private nature reserve at Watermill Broad, Cranwich, where the population has been monitored from 2015 to 2020. This note draws from the experiences of photographic identification of individual snakes within large populations and hopes to encourage and guide monitoring work elsewhere. In particular, we provide data on snakes initially captured as hatchlings to examine the stability of markings throughout the course of life of individual snakes.

Materials and methods

At both sites, snakes were captured either during standardised surveys using artificial cover objects or opportunistically. To record the identity of each snake the anterior ventral scales were digitally photographed. Snakes were held so as to keep the photographed area as straight as possible. They were either restrained in the hand or held against a neutral background. Digital images were cropped to include

[1] Recent taxonomic revision means that the Grass Snake has changed its name from *Natrix natrix helvetica* to *Natrix helvetica*, the Barred Grass Snake (Kindler *et al.* 2017).

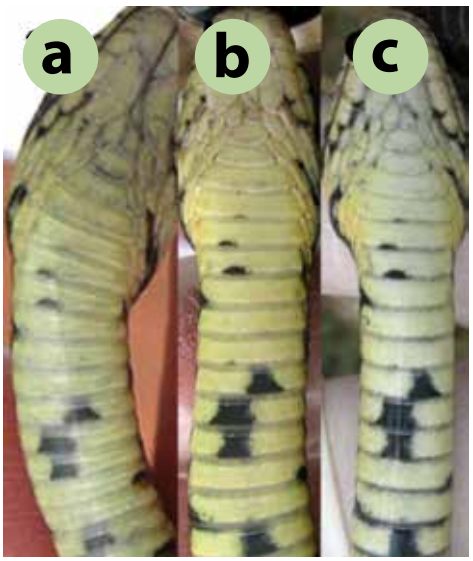

Figure 1. A male grass snake captured as a hatchling in 2006 (a) showing constancy of the ventral markings into maturity. The snake was recaptured in 2010 (b) and then again in 2011 (c) more than four and a half years after first capture.

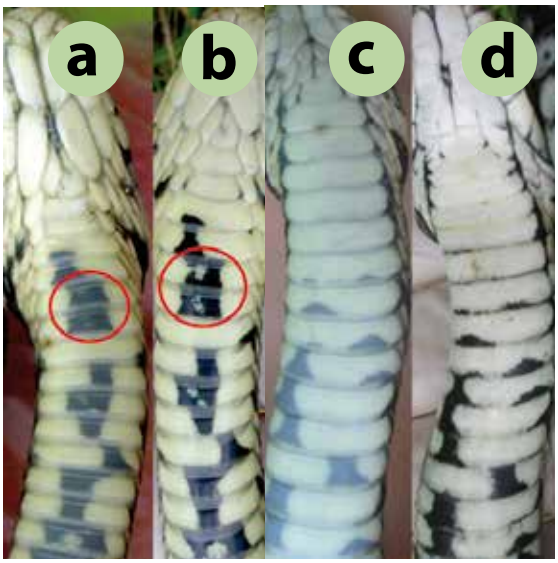

Figure 2. Changes in markings in two female grass snakes. The dark markings contracted in one snake, captured as a juvenile in 2015 (a) and then as an adult the following year (b). The dark markings of a second snake (c and d) lost definition over an eight-year period (2008-2016).

the underside of the head and the anterior ventral scales, settling on at least the first fifteen of the latter to facilitate visual comparison of the ventral markings. We identified the first ventral scale as the first one lying within the cleft of the gular scales that is broader than it is long, rather than the more strict definition of the first scale bordered by the first rows of dorsal scales (Dowling 1951).

Results

Stability of markings

Few hatchlings were found but at the first study site four were recaptured in subsequent years; one of these was recaptured only as a juvenile, the following year, but three were recaptured over longer intervals. Of these latter three, one female was recaptured as a two-year-old, a second as a three-year-old and a male was recaptured twice, as a three-year-old and a four-year-old. In all cases the ventral patterning was constant over time as exemplified by the male in Figure 1.

Although markings were highly constant between years, in two sets of recapture images subtle changes were noted; dark markings 'contracted' slightly in a young female whilst in an older snake they lost definition, becoming 'fuzzier' over an eight-year recapture interval (Figure 2).

Number of ventral scales required

The extent and pattern of markings varied considerably between individuals. In some cases elements of the patterning were similar between snakes (e.g. Figure 3), but inspection of a sufficient sequence of the ventral scales still allowed differentiation of individuals. A small proportion of snakes had very few markings on the foremost ventral scales, but we found that within the first fifteen or sixteen scales there were sufficient to distinguish individuals within more than 700 snakes captured.

Discussion

Our photographic records confirm Carlström and Edelstam's (1946) conclusions that the ventral patterns of grass

Figure 3 (left). A male first captured in 2009 (a) with elements of its ventral patterning similar to another male, captured as a juvenile in 2012 (b).

Figure 4 (right). Some individuals have very few markings within the anterior ventral scales (a), but recording the first fifteen or sixteen scales allowed discrimination of more than 700 individuals including one female (b) and one male (c) with only single obvious marks within the fourteenth ventral plate.

snakes remain highly constant. Our data demonstrate that this is the case over all life stages from hatchling to adult and over many years as an adult. Slight changes were noted in two individuals. In one the markings became less definite and increased in extent. In another, young, specimen the dark markings decreased in extent. In either case these changes were slight and did not impair individual identification.

Digital photographs of the ventral scale patterning were an effective means of identifying individuals. Madsen (1983) used records of the first ten ventral scales but within our sample some individuals had no obvious markings within the foremost plates (Figure 4) and the first fifteen or sixteen ventral scales were needed to capture sufficient patterning to allow discrimination of individuals within a large sample of Barred Grass Snakes (n > 700).

For small populations of Barred Grass Snakes comparing photographic records by eye is readily manageable. We recommend cropping images to include a constant number of anterior ventral scales (the foremost 15 or 16 seem sufficient) to aid visual comparison. For larger populations pattern recognition software such as Wild-ID (Bolger *et al*. 2011) may be helpful. The software program I^{3}S Straighten (Den Hartog & Reijns, 2015) is easy to use to straighten ventral images which makes it easier to crop unwanted background and may help the comparison process whether 'by eye' or using pattern recognition software. The use of such software significantly decreases the time required to identify photographic records of individuals (Sacchi *et al*. 2016).

The current ubiquity of digital cameras makes photographic identification readily achievable and some of the software to aid image processing is available for free via the Internet. Hence monitoring Barred Grass Snake populations is feasible with little or no financial outlay. Demographic information may be useful to site managers and could be particularly useful in learning about the impacts of snake fungal disease (Franklinos *et al*. 2017) on wild populations.

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