

Movements, mating and parturition in a female aspic viper, *Vipera aspis*, in western France

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INTRODUCTION

The aspic viper, *Vipera aspis*, is a small venomous viviparous snake of the western Palearctic region. It is heliothermic, basking in the sun to regulate body temperature. A capital breeder, females accumulate large amounts of energy before reproduction resulting in low reproductive frequency. Most females in western France apparently only reproduce once during their lifetime (Bonnet et al., 2002). Compared to non-pregnant females, pregnant females increase basking time substantially, display higher thermal preferenda and thermoregulate more precisely around thermal set points. Body temperature ranges of female *V. aspis* are within the highest level of thermal precision reported in squamates (Angilletta 2009; Lorient et al., 2013). The advantages of attaining thermal optima on the developing embryos are larger fitter offspring and fewer stillborn. However, this strategy compels pregnant females to bask in more open locations compared to non-pregnant females, which increases predation risk (Lourdais et al., 2004) especially from predatory birds (Naulleau et al., 1997; Lourdais et al., 2013).

Most research on *V. aspis* in western France has been undertaken in Department 44 (Loire-Atlantique; 47°03' N, 02°00' W) in a habitat consisting of a mosaic of meadows and regenerating scrubland (e.g. Bonnet *et al.*, 1999; Bonnet et al., 2002; Lourdais et al., 2014). However, behaviour and reproductive strategy may differ in other regions and habitats (e.g. Luiselli & Zuffi, 2002; Altweg et al., 2005) and hence additional observations are of interest. This note describes movements in a female *V. aspis* during 2014 and 2015 in western France, but in a fragmented landscape in Department 85 (Vendée; 46°27' N; 1°53' W) approximately 80km to the north of the Department 44 study locality, when mating and parturition were observed.

METHODS

Observations were made around a hibernaculum initially discovered during the spring of 2013. This consisted of a series of disused drainage pipes almost completely covered by soil situated in a hedgerow where the entrances were covered with an understory of bramble (*Rubus fruticosus*) and canopy of European ash (*Fraxinus excelsior*). The surrounding terrain was mainly agricultural land, small urban areas and patches of woodland, usually connected by

extensive hedgerows. Several species of reptile have been sighted annually around the hibernaculum since the spring and autumn of 2013 (see Meek, 2013; 2014). Surveying was by VES (visual encounter survey; McDiarmid et al., 2011) on most days during the active season (March – November) when the weather was favourable. Surveying was along the hedgerows to the north, north-east, west and south of the hedgerow where the hibernaculum was located and also a 10 - 15m strip of surrounding farmland (Fig. 1). In an attempt to minimize disturbance and disruption of normal activity during each visit, the hedgerows were surveyed only once during morning and once in the afternoon. When a sighting was made, observation time was limited to around 10 seconds maximum.

The female *V. aspis* had initially been identified from photographs at the hibernaculum during March 2013 and was readily identifiable thereafter. She was observed in the spring and autumn of 2014 through to the spring of 2016, but there were no sightings (or of any other viper) near the den during the summer. Estimated total length was 450 - 470 mm.

OBSERVATIONS AND DISCUSSION

Between 12 March and 22 April 2014 10 sightings were recorded around the hibernaculum but no reproductive activity was observed. The first sighting in 2015 was on the morning of 4 April when basking was observed near the main entrance to the hibernaculum in close proximity to two other individuals. A further 5 sightings were made in the main hedgerow including basking at 09.50h (CET) on the morning of 12 April near the entrance to the hibernaculum. Later the same day at 18.10h, in the same hedgerow, mating was observed with one of the other two vipers. Both individuals were resting motionless 200mm above the ground on a fallen log in dappled sunlight inside the hedgerow (log surface temp = 32.9C, air temp = 22.0C). The last spring sighting of the female was at 09.45h on the morning of 17 April basking in the main hedgerow close to the mating location.

The first autumn 2016 sighting was of basking in open or in semi-exposed locations alongside the western hedgerow on 4 September at 09.40h (Fig. 1). Sightings were daily each subsequent morning at the same locality (± 2 metres) and at 09.50h on the morning of 9 September parturition was observed. Time from mating to parturition



Figure 1. Aerial view (Google Earth) of the study area showing main locations of sightings. Large circle indicates area around the hibernaculum where post hibernation basking was observed, small circle = location of mating, triangle = site of parturition, cross = post parturition locations and diamond = sightings during spring 2016. Arrows along the northwest hedgerow indicate previous sightings of basking pregnant female *V. aspis*. See text for further details.

was thus 151 days, which is in good agreement for *V. aspis* in France (e.g. Bonnet et al., 2001) and Italy (Luiselli & Zuffi, 2002). Estimated number of offspring was a minimum of 6 but extensive plant cover at this time did not facilitate an accurate count. The snake was next sighted in the main hedgerow on 17 September at 17.35h, indicating a road crossing (Fig. 1). In total 10 autumn observations were made during 2015 the last on 9 October. The first sighting in 2016 was 21 April when basking was observed at a regularly used basking site. This indicated survival through the winter period after parturition. The first 2016 sighting was later than in previous years, but the spring was un-seasonally cold with frequent north winds, overcast days and cold nights. Only 3 observations were made, the last on 27 April.

The absence of summer sightings at the hibernaculum (including of other vipers) suggests migration to a summer home range. The hedgerows represent narrow stretches of linear habitat situated in an area of agricultural landscape with presumably limited resources. However, hedgerows function as movement pathways between prime habitat (Saint Girons, 1996) and in the study locality lead to woodland 200m to the north east and south circled around

a farm 360m from the hibernaculum. Returning to the area around the hibernaculum in early in autumn for parturition has been observed twice previously in other females (see Fig.1) and this behaviour may be adaptive. For instance, the population dynamics of *V. aspis* in some areas of Europe is driven by juvenile survival during the first winter when mortality may be higher than other age classes. It has been suggested that this is due to young individuals being less experienced in finding suitable winter quarters than adults (Altweg et al., 2005). Neonates born in the vicinity of frequently used and tried hibernacula in autumn may have enhanced chances of survival during the first winter. This would also support the notion of female *V. aspis* as ‘dedicated mothers’ (Lorioux et al., 2013).

It is recognized that there are limitations attached to the present observations, in particular the absence of summer movements, which could be achieved by radio tracking. Body temperature measurements would give insight into thermoregulatory precision but necessitate disturbance through measurement and hence potentially disrupt natural behaviour. It has been assumed that all vipers had left the area immediate to the hibernaculum during early summer but this could be attributed to sampling error, although would require repeated patterns in sampling error year on year. Additionally, foraging whip snakes (*Hierophis viridiflavus*) are frequently seen in the hedgerow during summer, remaining in the locality for periods up to 10 days at a time. Although *H. viridiflavus* is a larger species, for an experienced observer *V. aspis* is no more difficult to detect in a hedgerow.

The observations have value in that they indicate increased basking exposure during pregnancy with the associated increase in predation risk (e.g. Lima & Dill, 1990; Saint Girons, 1994). Non-reproductive females and males usually employed mosaic basking in dappled sunlight and selected basking locations deeper into dense vegetation (bramble for example), which substantially reduces predation risk, especially from raptors (e.g. Saint Girons, 1994). In general the observations agree with data from female *V. aspis* studied in Department 44 (e.g. Bonnet et al., 1999; Bonnet et al., 2002; Lourdais et al., 2014) indicating that thermoregulation, predator avoidance and reproductive behaviour in *V. aspis* are intrinsically linked.

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