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First record of autumnal mating in the iberian adder, *Vipera seoanei*

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RESUMEN: Las víboras europeas (género *Vipera*) presentan dos tipos de estrategias reproductivas ("berus" y "aspis"), lo que permite uno (primavera) o dos (primavera y otoño) períodos de cópulas. A diferencia de otras especies del clado *Pelias*, *Vipera seoanei* presenta el tipo "aspis", en el que los machos desarrollan el esperma a finales de verano y otoño, posibilitando la cópula tanto en primavera como en otoño. No obstante, el comportamiento sexual otoñal en esta especie es anecdótico, no existiendo registros de cópulas en este período. En esta nota se aporta la observación de una cópula otoñal en *V. seoanei* y se discuten las posibles ventajas ecológicas de esta estrategia reproductiva.

European vipers (Fam. Viperidae; genus *Vipera*) are a monophyletic group of small-medium sized venomous snakes distributed across Europe, with some species also reaching Asia and North Africa (Phelps, 2010; Freitas *et al.*, 2020). The genus is composed of three major clades (i.e. *Pelias*, *Vipera* 1 and *Vipera* 2), and includes about 20 species with contrasting climatic niches and major parapatric distributions (Phelps, 2010; Freitas *et al.*, 2020). All Euro-

pean vipers are viviparous and present marked patterns of sexual activity that are determined by the occurrence of two types of reproductive cycles (Saint Girons, 1992; Nilson & Andrén, 1997): (1) the "berus" type, generally occurring in cold-adapted species from the *Pelias* clade, in which males' sperm development starts in autumn (i.e. spermatogenesis) and finishes the following spring (i.e. spermogenesis), therefore leading to a single yearly mating period,

in spring, posterior to males' skin shedding; and (2) the "aspis" type, generally associated to warm-adapted species from both *Vipera* clades, in which males' sperm development (both spermatocyto- and spermiogenesis) occurs in summer-autumn (i.e. aestival spermatogenesis), therefore leading to two potential mating periods, one in autumn and another in spring, both independent of males' skin shedding. Accordingly, males of the "berus" species do not store sperm in the *vas deferens* for a long time, whereas males of the "aspis" species present sperm during the whole year, particularly increasing the quantity from autumn to spring (Saint Girons, 1992).

The Iberian adder, *Vipera seoanei* Lataste 1879, is a small European viper, nearly endemic to the Iberian Peninsula, which is restricted to regions with Atlantic climate in northern Portugal and Spain, and southwestern France (Martínez-Freiría & Brito, 2014). The species belongs to the *Pelias* clade, and is phylogenetically sister species to the common

adder, *Vipera berus*, but presents the "aspis" reproductive type (Martínez-Freiría & Brito, 2014; Freitas *et al.*, 2020). In *V. seoanei*, mating is well-known to occur in spring, from late March to early May, and to be non-dependent of males' skin shed (Nilson & Andrén, 1997; Martínez-Freiría & Brito, 2014). Autumnal sexual activity has been anecdotally recorded and, although mating has never been reported (see Martínez-Freiría & Brito, 2014), there is a recent observation of a male courting and attempting to copulate with a female during three days in September in the French Pyrenees (Pille & Bonnet, 2018). In this note, we report one observation of autumnal mating in *V. seoanei*.

During a fieldwork campaign developed on 20 September 2020 in the municipality of Palas de Rei (Lugo, Spain; UTM NH9456; 590 masl), two adults of *V. seoanei* were observed together at 13h (solar hour) by the first author of this note. Vipers were laying on the proximity of a stone-wall, southwards orientated and surrounded by bushes (*Rubus* sp.)



Figure 1: Male (with blackish zigzag over pale background) and female (with brownish zigzag over orange background) of *V. seoanei* with cloacas already disengaged, after mating observed on 20 September 2020.

Figura 1: Macho (con zigzag negruzco sobre fondo pálido) y hembra (con zigzag marrón sobre fondo naranja) de *V. seoanei* con las cloacas ya sueltas, tras la cópula observada el 20 de septiembre de 2020.

and herbaceous vegetation, at 590 m of elevation. The habitat is composed of patches of *Quercus robur* forests, mowing meadows and scrublands (with *Ulex europaeus*, *Erica* sp. and *Cytisus scoparius*). Climate is temperate with temperate summer, mean annual temperature of 10° C and 1000 mm of annual precipitation (Chazarra Bernabé *et al.*, 2018). Vipers were immediately recognised as male and female due to their contrasting colouration and size (Figure 1). The male, thinner than the female, in part because the female had recently eaten a prey, was located over the female, performing jerky movements with the head and rubbing the body with that of the female. Cloaca of both male and female were joined together. However, vipers disengaged cloacas and escaped in opposite directions when the observer approached to photograph the scene. Another adult male was found at about 1 m of distance.

In a seminal work, Nilson & Andrén (1997) related reproductive types of clades and species within Palearctic vipers (i.e. *Daboia*, *Eristicophis*, *Macrovipera*, *Montivipera*, *Pseudocerastes* and *Vipera*) to the occurrence of marked environmental differences across their ranges. Although the reproductive type is still uncertain for some European viper species (see Phelps, 2010), there is an evident biogeographic pattern where cold-adapted *Pelias* species present the “berus” type, while warm-adapted *Vipera* species have the “aspis” type (Saint Girons, 1992; Nilson & Andrén, 1997). *Vipera seoanei* was already referred as the exception to this pattern (Saint Girons, 1992; Nilson & Andrén, 1997; Phelps, 2010) and the observation reported in this note reinforces the occurrence of the “aspis” reproductive strategy, while confirming that reproductive activity during autumn can actually lead to mating in the species.

Two mating periods occur in the other Iberian viper species (Saint Girons, 1992; Pleguezuelos *et al.*, 2007). The spring mating period has been referred as the principal in *V. aspis* across its distribution range, while autumn mating seems to be less important (i.e. with fewer males participating and along a shorter period) and dependent on the occurrence of favourable climatic conditions (see Martínez-Freiría, 2014). Curiously, in *Vipera latastei* the mating period varies geographically across the Iberian Peninsula, with observations either in spring (e.g. in Doñana N.P., Huelva, Spain; in Sedano Valley, Burgos, Spain) or autumn (e.g. in Peneda-Gerés N.P., northern Portugal; in the Garraf Massif, Barcelona, Spain) (Pleguezuelos *et al.*, 2007), likely as result of geographic variation in climatic conditions. In *V. seoanei*, records of autumnal reproductive activity were reported for western (Balado *et al.*, 1995; this note) and eastern (Pille & Bonnet, 2018) parts of its distributional range. Still, information on reproduction is scarce for *V. seoanei* and whether the occurrence of autumn mating is related to geographic and/or seasonal variations in climatic conditions deserves to be studied, for instance using radio-telemetry techniques to monitor vipers’ activity across populations (e.g. Brito, 2003; Martínez-Freiría *et al.*, 2010).

The occurrence of two mating periods could represent an ecological advantage in warm environments. A recent macro-ecological study on the monophyletic group of Eurasian vipers (i.e. *Daboia*, *Macrovipera*, *Montivipera* and *Vipera*) has highlighted that some phenotypic traits such as dorsal pigmentation play an important role in species thermoregulation in particular (cold) environments and therefore, are subject to natural selection (Martínez-Freiría *et al.*, 2020). The reproductive strategy described

for *V. seoanei* could be in fact result of local adaptation or phenotypic plasticity, as has been suggested for other phenotypic traits that vary intraspecifically in *V. seoanei*, such as scutulation or body size (Martínez-Freiría & Brito, 2013; Lucchini *et al.*, 2020). Recent insights into the evolutionary history of the species pinpointed climatic variability, particularly the increases of temperature associated to interglacial periods of the Pleistocene, as major factor constraining species persistence (Martínez-Freiría *et al.*, 2015). Under this scenario, a flexible reproductive strategy, which allows two mating periods in accordance to climatic variability, could be advantageous and therefore, could have allowed species persistence.

Given that fertilization in *V. seoanei* and other *Vipera* species occurs in spring (i.e. aestival vitellogenesis; Saint Girons, 1992), sperm

must overwinter either in the genital ducts of males (spring matings) or in those of females (autumn matings). This raises a biologically relevant question about the differential survival of sperm in each sex during winter and the evolutionary consequences of such ecological constraints. Undoubtedly, the role of both reproductive strategies in the evolutionary history of European vipers, as well as the ecological advantages behind the occurrence of one or two mating periods, deserve further investigations.

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Un ejemplar concolor de *Psammodromus algirus*

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El término “concolor” se refiere a un patrón de coloración sin un diseño oscuro de manchas, en el cual el ejemplar sólo muestra la coloración base, sin presentar sobre ella un patrón oscuro o diseños contrastados. Dicho patrón ha sido descrito en lacértidos, en diversas especies del género *Podarcis*, como *P. bocagei* (Pérez-Mellado, 1980; Galán & Vázquez, 2010; Ayres-Fernández, 2020), *P. carbonelli*, *P. ionicus*, *P. sicula* y *P. melisellensis*, así como en *Scelarcis perspicillata* e individuos de los géneros *Dalmatolacerta*, *Dinarolacerta*, *Lacerta*, *Darevskia* e *Iberolacerta* (Pérez-Mellado, 1998; Arnold *et al.*, 2007; Jablonski & Christophoryová, 2016; Ayres, 2019). Sin embargo, la información sobre la presencia de patrones anómalos de colora-

ción en *Psammodromus algirus* es escasa. Doñaire *et al.* (2011) mencionan la de un morfo concolor de esta especie en el Rif (Marruecos) y Salvador (2015) la de algunos ejemplares que presentan falta total de diseño.

El día 20 de junio de 2020 fueron observados en la ribera del río Manzanares, a la altura del barrio de Mingorrubio, Madrid (coordenadas UTM 30T 433676 / 4486770; 609 msnm), dos ejemplares de *P. algirus*, uno de los cuales correspondía a un morfo concolor, sin las líneas amarillentas típicas del dorso y cabeza que suele tener el fenotipo habitual de la especie (Figura 1a), presentando el otro ejemplar una coloración normal. El individuo concolor se refugió entre la vegetación de ri-



Figura 1: a) Ejemplar concolor de *Psammodromus algirus* de Mingorrubio (Madrid). b) Hábitat donde fue detectado.

