

Biting as an intraspecific behaviour of a male Common European Adder (*Vipera berus*, Linnaeus 1758) during courtship and mating competition

Beißen als Teil des intraspezifischen Verhaltens während der Werbung und der Paarung bei der Kreuzotter (*Vipera berus*, Linnaeus 1758)

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Zusammenfassung

Der Artikel beschreibt die Beobachtung des Beißens als Teil des intraspezifischen Verhaltens während der Werbung und der Paarung bei der Kreuzotter (*Vipera berus*). Bei Giftschlangen ist dieses Verhalten eher selten und wurde noch nie bei wildlebenden Kreuzottern beobachtet. Das Verhalten wird mit ähnlichen Beobachtungen bei verschiedenen Schlangenarten verglichen und mögliche Ursachen diskutiert.

Abstract

The article describes the first record of biting as an intraspecific behaviour of a male Common European Adder (*Vipera berus*) during courtship and mating. In venomous snakes this behaviour is rather rare and in *Vipera berus* this is the first time it has been observed in the wild. This behaviour is compared to similar observations in snakes and potential reasons are discussed.

1. Introduction

On May 9th 2021, a film team recorded the mating activity of a pair of *Vipera berus* in Kiel, Schleswig-Holstein Northern Germany. They were able to film an unusual and very rare behaviour concerning male-male interaction.

The population is one of the last known occurrences of the endangered species in the district of Kiel. The habitat is a succession site, pioneer forest and old railroad tracks connected to the active tracks. The primary habitat of the species, a mire, is heavily degraded and not suitable any more due to melioration and succession. Presently, there is no active management, which has led to a loss of

habitats (Pohlmann & Schmersow 2020). Although urban habitats are rare, the situation is typical for the status of *Vipera berus* populations in Schleswig-Holstein, as an enhanced succession due to melioration and growing nutrient input is a common threat (Klinge & Winkler 2019).

2. Observation

At 14:20, CET a basking female was observed on an overgrown pile of gravel near the active railway track. At 15:07, CET a male appeared and started to crawl on



Fig. 1: Competitive male Adder (*Vipera berus*) bites female gently during her copulation with another male without using fangs (Photo: U. Anders).

the female trying to stimulate the female by twitching, which is a well-documented behaviour during courtship (Andrén 1986).

At 15:58, CET while the observed couple was still copulating, a second male arrived. First, it tried to separate the two other snakes by scrambling for 25 minutes without success. The second male left the place for a short time (3 minutes). Then it returned and displayed a vigorous behaviour towards the copulating couple. It ignored the copulating male while it showed great interest in the female represented by intensive tongue flicking and crawling over its body. It subsequently started to stimulate the female by twitching like the first male before, but with more intensity. As a newly recorded behaviour, the additional male did gently bite the female at 16:48, CET. As shown in Fig. 1 the solenoglyphous fangs were not erected. Once more, it tried to disrupt and separate the couple by “tail wrestling”. Having no success the concurring male did bite the copulating male vigorously at 17:04, CET (Fig. 02). It is unclear if it used its fangs. In the end, the disrupting male had no success. The copulating couple disappeared at 17:20, CET.

3. Discussion

Biting has been documented as an intraspecific interaction of snakes almost exclusively during courtship, primarily in Colubrids (Vitt & Caldwell 2009, Senter et al. 2014) but was also observed in venomous species, especially in Viperidae as agonistic behaviour against mating competitors (e.g. Shine 1994). There is also one observation of biting as interspecific behaviour in Garter Snakes in competition for food (Edgehouse et al. 2014). Mating behaviour and ritual combats are well known and documented for *Vipera berus* (e.g. Andrén 1986). Duvall et al. (1993) stated *Vipera berus* to be the “perhaps best studied snake with respect to its mating systems in nature”. The standard works (Nilson et al. 2005, Otte et al. 2020) do not mention biting as part of courtship or agonistic behaviour. Beside our observation, to the best of the authors knowledge, there exists only one published report of biting as behavioural pattern in ritual combats as well as during courtship in *Vipera berus* (Hromádka & Vozenilek 1976). Krecsak & Toth (2005) describe different cases of biting as part of male-male combat in *Vipera renardi*, whose competitive behaviour of males is similar to *Vipera berus*. The observations were exceptional cases referring to the behaviour of specimens in captivity.



Fig. 2: Competitive male Adder (*Vipera berus*) bites copulating male vigorous (Photo: U. Anders).

In the presented case, biting took place during courtship on the one hand as well as the suspected intention to disrupt a copulating couple on the other hand. Shine et al. (1981) described the latter for *Pseudechis porphyriacus*. In captivity, a similar behaviour was observed in *Crotalus durissus terrificus* (Almeida-Santos et al. 1999). In *Trimeresurus macrops* biting is documented for a copulating male fighting a competitor (Strine et al. 2018). Mate guarding, including biting a competitor has been described for *Bogertophis subocularis* (Rehák 1990). Biting as part of male-male rivalry behaviour in snakes in general has been documented for a few other snake species, but is still a rare event (Senter et al. 2014) and has mainly been witnessed in captivity (Rehák 1990, Strine et al. 2018). In the case of venomous snakes, highly ritualized male-male-combats are more common (Gillingham 1987 in Rehák 1990), which also applies to the behaviour of *Vipera berus* (Andrén 1986). The degree of aggressive behaviours of snakes and in male-male interactions in particular vary in between species (Rehák 1990). The fact that the male *Vipera berus* did not use its fangs agrees with the description of “gentle bites” given in Rehák (1990) referring to (Hromádka & Vozenilek 1976). In contrast, the male *Trimeresurus macrops* used its fangs and even signs of enve-

nomation occurred (Strine et al. 2018). *Vipera renardi* males also used their fangs, but without visible effects (Krečsak & Toth 2005).

The reason why the males did bite is very likely intrasexual competition (Rehák 1990) which may lead to intrasexual violence and aggression. Krečsak & Toth (2005) describe bites being employed only as means of last resort.

In the case of individuals kept in captivity, an explanation should be an unnatural high population density and the lack of opportunities for a defeated male to retreat (Almeida-Santos et al. 1999, Krečsak & Toth 2005, Senter et al. 2014, Strine et al. 2018). In a male-male combat of *Corallus enhydris enhydris* the aggressiveness increased because the weaker male could not retreat, also the intensity of bites of a dominant male *Lampropeltis getula californae* increased because the subordinate male could not flee (Rehák 1990).

Although our described observation of a biting male *Vipera berus* was made in the wild, the reason might be equivalent.

The degraded habitat in Kiel is rather small and other negative impacts like persecution by humans do occur (Pohlmann & Schmersow 2020). Although the population did decline over the last years, the population

density might be relatively high in comparison to the amount of suitable habitats. Records of juveniles are very rare, which leads to the assumption that the population structure is already disrupted. Although more females were detected, the actual gender distribution is not clear because the snakes were not identified individually (Pohlmann & Schmersow 2020) and the detectability varies throughout the season and in between sexes (Bauwens & Claus 2019). However, even within populations with a balanced allocation of sexes a scarcity of reproductive females do occur, due to the non-annual reproductive cycle of females (Bauwens & Claus 2019). In years with a lower availability of reproductive females, mating strongly depends on male-male-combat success (Madsen et al. 1993).

The documented male-male combat of *Trimeresurus macrops* also took place in an anthropogenic degraded urban area (Strine et al. 2018), which may cause familiar pressures to the local population.

The current observations demonstrate that in the case of *Vipera berus*, there was a notable difference between gentle bites during courtship and a vigorous bite to fight a competitor. Nevertheless, both situations are quiet uncommon and the explanation for both bites might be an increased sexual arousal of the second male. Due to this heightened sexual arousal, the gentle bite became a part of the courtship behaviour because the copulating female did not retreat but there was no opportunity for the male to copulate. In this situation, the increasing arousal in combination with missing mating success led to a higher level of aggression and a strong agonistic reaction to the copulating male.

The in-depth description of mating and male-male combat in *Pseudechis porphyriacus* (Shine et al. 1981) leads to the assumption that biting might also be an individual behaviour of single animals. Behaviour may differ individually in snakes (Schuett 2016). Biting as an individual behaviour might explain the scarce observations of intraspecific bites in *Vipera berus*.

4. Conclusion

According to the current scientific knowledge the mating system, courtship and male-male combat behaviour in snakes is species dependant. In the observed case, an enhanced intraspecific mating competition might have caused the biting of the disturbing male. A high population density and disrupted population

structure (e.g. low number of females) may have lead to an enhanced intensity of intrasexual competition and a higher level of aggression.

Nevertheless, it might also be more an individual response to the lack of mates than a characteristic of the species itself.

The discussed observation of biting *Vipera berus* during courtship as well as in male-male combat shows gaps in knowledge even in the well-investigated mating behaviour and ritual combats of this species and emphasize the need for further research. Nature documentary films can carry a beneficial potential to reveal unknown behaviours.

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