

# MALE COMBAT IN TWO SPECIES OF MOUNTAIN VIPERS, *MONTIVIPERA RADDEI* AND *M. WAGNERI*

JEFF ETTLING AND ADAM MARFISI

**ABSTRACT:** The Mountain Viper (*Montivipera xanthina*) complex is distributed throughout extreme southeastern Europe, Asia Minor, adjacent Russia, and parts of western Asia. This complex is comprised of eight species in two clades, and little information is available on their biology in nature or captivity. Here we report male combat behavior in one species of each clade (*M. raddei* and *M. wagneri*). Ritualized combat in these two species is similar to that reported in other viperid snakes.

## INTRODUCTION

The Mountain Viper (*Montivipera*) complex is composed of eight species in two clades: the *M. xanthina* group (*M. albizona*, *M. bornmuelleri*, *M. bulgardaghica*, *M. wagneri*, and *M. xanthina*), and the *M. raddei* group (*M. albicornuta*, *M. latifii*, and *M. raddei*) (Nilson et al., 1999; Lenk et al., 2001). We have limited knowledge of their biology in nature, which in part is due to their isolated, restricted distribution (Nilson and Andr n, 1986). Darevsky (1966) and Bozhanskii and Kudryavcev (1986) studied the ecology of *M. raddei* in the mountains of Armenia and briefly described reproductive behavior and timing of mating, respectively. Here, we describe male combat in captive Radde's Rock Viper (*M. raddei*) and Wagner's Viper (*M. wagneri*), and make anecdotal comparisons to related viperids. The genus *Montivipera* was formerly recognized as *Vipera*. Detailed observations have been published on male combat behavior of several species of *Vipera*, especially for *V. berus* (Prior, 1933; Prestt, 1971; Nilson and Andr n, 1982; Andr n, 1986; Madsen et al., 1993), but few accounts are available for the *Montivipera* complex.

## MATERIALS AND METHODS

Observations were made at the Saint Louis Zoo on two male *M. raddei* from unknown localities. The snakes measured 88.4 and 82.7 cm in total length (TL), and both were acquired on 25 April 1996. The two male *M. wagneri* used in this study were born in captivity at the Saint Louis Zoo on 28 June 1995, and measured 67.1 and 61.2 cm TL. Additional observations involved two male *M. raddei* in the senior author's private collection. Both specimens were from unknown localities and measured 76.2 cm TL, and they were acquired on 4 September 1993, and 6 October 1994.

The snakes were maintained in fiberglass units (L87.6 x W55.8 x H45.7 cm) with glass doors. Enclosure furnishings consisted of shredded aspen substrate, rock arrangements, and a water bowl; the rocks provided both hiding and basking opportunities for the snakes. Ambient temperature was maintained between 17–25°C. Cage lighting was provided by two 40W fluorescent bulbs (one Duro-Test Vita-Lite<sup>®</sup>, one Sylvania BL 350<sup>®</sup>), and photoperiod was controlled by electric timers. Depending on the month, photophase length varied from 15 h (June) to 2 h (December to March) when animals were in hibernation. Windows provided a natural photoperiod. Basking spots (27–30°C) were created using 50W incandescent spotlight bulbs. The snakes were fed a diet of pre-killed laboratory mice every 2–3 weeks during active periods.

In order to stimulate reproductive behavior, a cool, dark dormancy period was provided between mid December and mid March by using a refrigerated room equipped with a programmable thermostat (Ettling, 1996). Prior to initiating the hibernation cycle all specimens were fasted 3–4 weeks to clear their gastrointestinal tract. In mid December the snakes were moved into individual enclosures (L57.2 x W41.6 x H14.6 cm) and placed in the refrigerated room. Fresh water was available ad libitum during hibernation. The temperature was initially set at 24°C and lowered in 2°C increments on a daily basis, until room temperature reached 10°C. At the end of the hibernation cycle (mid March) the temperature was raised 2°C daily, until the ambient temperature reached 24°C. Combat behavior occurred 4–6 weeks post-hibernation and usually coincided with the completion of ecdysis. Observations of combat behavior on 1 May 2000 involving *M. wagneri* were recorded on 8 mm videotape for analysis.

## OBSERVATIONS

Names of combat acts follow Andr n (1986) and Schuett and Gillingham (1989). On 11 April 1999, at 0710 h, combat behavior was noted between two male

*M. raddei* (Ma and Mb) housed with a female. Both males had undergone ecdysis the previous day. As one male approached the other, both snakes began rapid tongue-flicking, raised their heads from the substrate, and ascended in a vertical posture. The snakes kept their heads in a bent position, parallel to the substrate, as they continued their ascent. The typical orientation of the snakes relative to one another was either ventrad-to-dorsad or laterad-to-laterad. Each male was attempting to keep its head higher than the other. At times 40–50% of the anterior body was elevated vertically off the substrate. In this position, the snakes began swaying from side to side. During the vertical display one male would attempt to entwine its head and neck around the body of its opponent by hooking either to the left or right. The opponent would respond by increasing the swaying movements and stiffening of the body, which resulted in the snakes toppling to the substrate and re-initiating the vertical posture. Neither male was ever able to hook more than one loop of its head and neck around its opponent during the vertical displays. Individual bouts averaged 2–3 min. Combat behavior continued until 2100 h when the snakes were separated. During initial bouts the female became alert and elevated her head. As the males crawled over her she gaped her cloaca for a period of 1–2 min and moved her tail from side-to-side (see Schuett and Gillingham, 1988).

On 13 April 1999, at 1030 h, combat behavior was observed between two male *M. raddei* (Mc and Md). Combat began when one male was introduced into the enclosure of another male and two females. At the time of introduction both females and the male were clustered together on a rock under the basking lamp. Movement by the introduced male initiated intense tongue-flicking and forward advancement by the resident male. As they came into contact, jerking body movements were displayed and they began to ascend from the substrate in a laterad-to-laterad position. As previously noted, each male attempted to keep its head in a superior position to the other by assuming a higher vertical stance. When approximately one-third of the body was elevated vertically, attempts were made by one of the males to entwine its head and neck around the body of the other. When one male succeeded in his attempt, he would begin rocking back and forth. This action resulted in both snakes toppling to the substrate, where they disengaged and resumed the vertical posturing. After two or three bouts, which generally lasted under 2 min, the males would often begin crawling around the enclosure. When they encountered each

other, combat would once again resume. It should be noted that the introduced male had completed ecdysis on 6 April 1999, whereas the resident male did not complete ecdysis until 19 April 1999. The females were present during the agonistic activity, and continued to bask and would occasionally tongue-flick. No cloacal gaping was observed.

The agonistic contests described above continued for some time without an obvious victor. This may be due, in part, because the males were of equivalent size, or perhaps was an artifact of captivity.

On 1 May 2000, at 1330 h, combat was observed between two male *M. wagneri* housed with a single female. Combat was initiated after attempting to feed the snakes pre-killed mice. As the males approached each other there was rapid tongue-flicking, immediately followed by the snakes assuming a vertical posture with the anterior body (15.3–25.4 cm) elevated off the substrate. The orientation of the snakes relative to each other was either ventrad-to-dorsad or laterad-to-laterad. As in combat bouts involving male *M. raddei*, each subject tried to assume a higher position relative to the other while attempting to entwine itself around its opponent. This behavior resulted in the opponent stiffening its body and swaying from side to side in an attempt to break free. During these vertical displays neither male was able to hook more than a single loop around its opponent before being thrown free. The three bouts observed between the two males lasted from 3–8 min. During the latter bout there were ca. 62.5 attempts made by the snakes to entwine each other. As the snakes were engaged in this behavior they made a circular course through the enclosure. The female was alert to the combat activity and oriented her head in the direction of the males and tongue-flicked rapidly.

## DISCUSSION

From studies involving both captive and free-ranging viperids (Carpenter et al., 1976; Shine, 1978, 1994; Akester, 1979; Murphy, and Barker, 1980; Gillingham et al., 1983; Andren, 1986; Schuett and Gillingham, 1989; Schuett, 1997), observations indicate that male combat behavior is similar among species of the family Viperidae. This behavior is typically initiated after males have tongue-flicked each other or by the movement of one individual in the vicinity of the other. Combat involves vertical posturing and physical contact until dominance is established and the subordinate retreats. The behaviors we observed in *M. raddei* and *M. wagneri* concur with

those documented in the literature for related species (e.g., *Vipera*). Due to the size similarity of the males in our group, it was never apparent that any one individual established dominance. Our observations indicate that after lengthy periods (approximately 15 h in one observation involving *M. raddei*) the snakes would tire and cease combat encounters.

Our accounts of male combat in *M. raddei* are similar to the description that Darevsky (1966) gave for courtship behavior in this species (see Schuett et al., 2001). Darevsky's account stated that "Both, one-third of the body erected in 'S' form, start swaying, the male trying now and then to push the female's head to the ground by violent thrusts. After succeeding to force the head down for several times both drop abruptly, intertwine their bodies rope-like leaving free a small part near the head." An observation of combat behavior between two male *M. raddei* on 27 April 2000, at 1345 h, showed wrapping of the posterior trunks and tails, similar to what Darevsky noted in the "courting" pair. We did not observe this behavior in previous combat bouts between these two males. In several species of snakes the completion of the ecdysis cycle serves as the stimulus initiating combat behavior (Andrén, 1986). It is difficult to explain, however, why the presentation of mice stimulated combat in *M. wagneri*. As unusual as this stimulus may seem, other researchers have reported that reproductive behavior can be induced as a result of food presentation (e.g., Radcliffe and Murphy, 1984).

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