Herpetological Bulletin (2013) 126: 25-29

Short Note
Male-male ritual combat in *Spilotes pullatus* (Serpentes: Colubrinae)

DIEGO FERREIRA MUNIZ-DA-SILVA[1,2*] and SELMA MARIA ALMEIDA-SANTOS[1]

[1]*Laboratório de Ecologia e Evolução, Instituto Butantan, Av. Vital Brazil, 1500, 05503-900 São Paulo, SP, Brazil*

[2]*Setor de Anatomia, Departamento de Cirurgia, Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, Av. Orlando Marques de Paiva 87, 05508 270 Cidade Universitária/São Paulo, SP, Brazil.*

[*]Corresponding author e-mail*: diegomuniz.vet@gmail.com*

INTRODUCTION

Some males snakes present morphological changes during reproduction in the breeding season and also display social interactions, such as male-male ritual combat. Ritual combat involves the interaction between two males, apparently in competition for mating dominance (Carpenter, 1977). Generally, the ritual consists of bodily contact between males. They exert pressure, either by pushing or twisting one another, with the goal being to physically dominate an opponent by forcing their head toward the ground (Carpenter, 1977).

Combat between males has been described for several snake taxa; Boidae, Elapidae, Viperidae and Colubridae (Carpenter, 1977; Shine, 1978, 1994; Almeida-Santos & Marques, 2002). Different taxa exhibit different behaviour during a ritual. During combat colubrids tend to assume a horizontal posture with trunk and tail regions entwined and some oblique or slight vertical elevation of the head (Carpenter, 1977). Combat is usually observed during the breeding season (Capula & Luiselli, 1997; Schuett, 1997; Schuett et al., 2001) and factors such as body size of the male and previous combat experience are important for victory in combat and mating success (Schuett, 1997).

The genus *Spilotes* (Wagler, 1830) (Colubridae, Colubrinae) comprises one species, *Spilotes pullatus*. It is a widely distributed snake, inhabiting areas of Central and South America from Tamaulipas in Mexico to Paraguay, and across the extreme northeast of Argentina (Savage, 2002). It is a diurnal, terrestrial and arboreal (Vanzolini et al., 1980; Sazima & Haddad, 1992; Marques, 1998; Boos, 2001; Marques & Sazima, 2004; Pontes & Rocha 2008).

METHODS

The description of ritual combat by *S. pullatus* herein was based on footage and detailed notes from four observations. The four instances detailed combat in situ in Brazil. Ritual combat #1 and #2 were observed in the southeast region, on Cardoso Island in the municipality of Cananéia, state of São Paulo (25° 7'S 47° 57'W) in early spring. Ritual combat #3 and #4 were observed in the central-west region of Brazil in late spring and early summer respectively. Combat #3 was filmed on the left bank of Sucuriú River (19º 08' 30"S 52º 58' 03"W), Paraiso Farm, municipality of Costa Rica, state of Mato Grosso do Sul and combat #4 was filmed at Vagafogo Farm (15º 50' 14.62"S 48º 58' 33.35"W), municipality of Pirenópolis, state of Goias (Table 1).

RESULTS

Description of the ritual

Males of *S. pullatus* kept their bodies partially entwined during combat (Fig. 1). The intensity at which the bodies became entwined varied. Specimens tried to keep the cranial portion of the body in the most upright position, trying to raise their heads as far as possible above the ground (Fig. 1a and 1d). The male that was disadvantaged in rituals retreated its head, loosened its body from the entwined posture,

Case	Season Date	N specimens	Combat	Copulation behaviour	Duration	Place
#1	Austral spring 12 Oct 2000	3	X	X	-	Cardoso Island-SP
#2	Austral spring Oct 2001	3	X	X	-	Cardoso Island-SP
#3	Austral spring 13 Dec 2007	2	X*	-	+ 1 hr	Costa Rica-MS
#4	Austral summer 26 Dec 2012	2	X	-	+ 1 hr	Pirenópolis-GO

Table 1. Male-male ritual combat in *S. pullatus* observed in situ. (x) observed; (-) not observed; (*) hemipenial exposition.

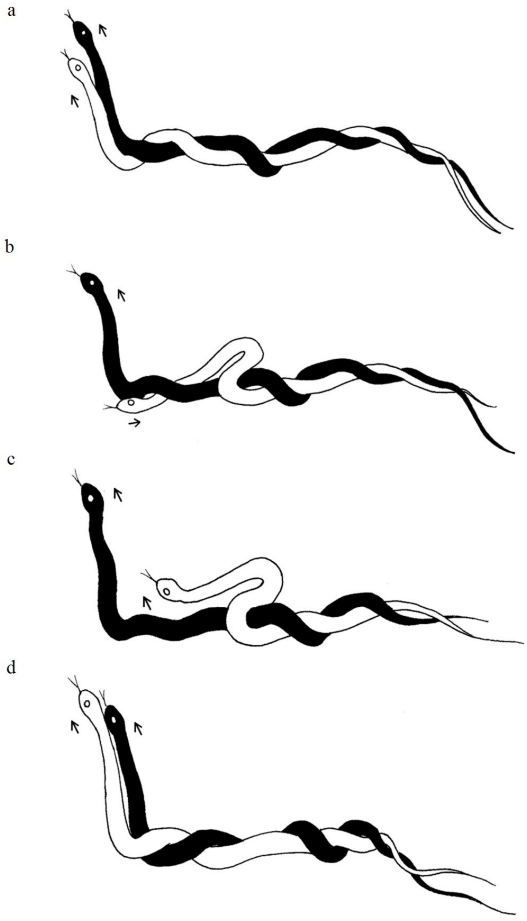

Figure 1. Male-male ritual combat in *S. pullatus.* A. The males try to keep their heads as high as possible. B. The male that is at a disadvantage (white) retreats its head and loosens a portion of the body twining. C. After gaining free space with the body, the male that retreated (white) places its head up again. D. At this time, this male (white) is able to keep its head higher than the opponent (black). The arrows indicate the direction of the movement performed by the individuals.

and placed its body back to a vertical position by raising its head above that of its opponent (Fig. 1b and 1c). Throughout each combat ritual, the snakes also used their tails to restrain their opponent by preventing forward locomotion. Bites were not observed during rituals.

Observations of male combat

Case #1: One *S. pullatus* was observed near the curb of a sidewalk while a second individual approached. The two paired their heads and a third individual approached while the other two were exhibiting courting behaviour. One of the snakes (probably a male) interrupted the courtship behaviour to pursue the third individual, who fled. The "pursuer" returned to courtship and the third snake, which had been chased away, approached the courting pair again. It was pursued a second time and finally chased away by the "pursuer". The pair remained copulated and later were observed mating on a lemon tree.

Case #2: Three individuals were observed together, two keeping their heads raised on display and later in combat. After a short period two of the snakes engaged in copulation. The third individual was no longer near the site.

Case #3: This episode occurred on the banks of a river. Males were entwined and repeatedly tried to keep the cranial part of their body raised above their opponent's. During certain moments, the tail was used in an attempt to immobilize the opponent and, on some occasions, it was possible to observe a brief exposure of the hemipenis of one individual. Combat occurred in low-lying vegetation and partly among

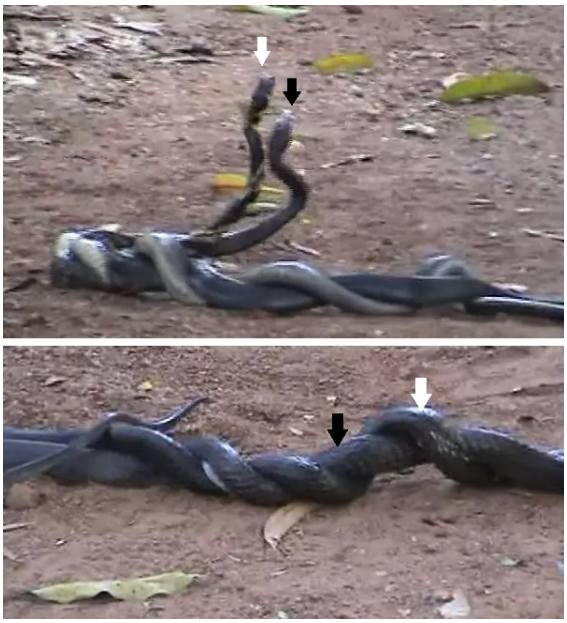

Figure 2. Two males in combat. Note that the smaller male (white arrow) tries to immobilize the larger male (black arrow) keeping his body intertwined with its opponent.

terrestrial substrate. During combat the snakes fell off branches. The beginning of the ritual was not observed and it lasted for approximately one hour.

Case #4: On a dirt road two males were sighted already commencing combat. The snakes kept their bodies entwined throughout combat, although it was noticeable that the smaller male intertwined its body more than the larger male in an attempt to immobilize its opponent (Fig. 2). After a period approximately one hour the larger male gave up and retreated to a tree nearby. The smaller male then chased the losing individual away.

DISCUSSION

Reproductive behaviour in snakes involves courtship, copulation, and in some species, mate guarding or surveillance that can lead to combat between males (Carpenter, 1977; Almeida-Santos et al., 1999). Of the approximately 2700 known species of snakes, combat has been recorded for only 6% of species (Schuett et al., 2001).

Combat ritual among colubrids was described by Carpenter (1977) and reported to be horizontal, with the snakes rarely raising the head and neck regions off the ground. The only previous exceptions were species such as *Elaphe longissima* and *Ptyas mucosa* that raise the cranial part of the body to try to force the opponent's head toward the ground. Almeida-Santos & Marques (2002) reported that *Chironius* did not fit this general pattern for colubrids since the species displayed a combat ritual where males tended to maintain the cranial portion of the body vertical. This posture of lifting the cranial portion of the body is more typical of Viperines. *S. pullatus* also fits the pattern demonstrated by *Chironius* and both genera are semi-arboreal. This suggests that semi-arboreal colubrids may engage in combat ritual in a similar manner to viperines and not adopt a standard horizontal position as other colubrids do. Although there is a similarity in the position of the combat ritual of *Spilotes* with that of vipers, it appears different because male vipers often try to push the opponent's head against the ground (Carpenter, 1977). This suggestes that a possible goal of the behaviour is to restrain, through physical force, the head of the rival. For *S. pullatus* the goal of the combat ritual seems to be to keep the head higher than that of the opponent, possibly to boast that it is the larger individual. Schuett (1997) demonstrated that male size is important for success in combat and influences mate selection by females. The fourth ritual (case #4) showed clearly that larger males are not always more dominant than smaller ones and it is possible that a male with more energy may have the advantage during combat. Combatant snakes that did not become fatigued in our observations were able to remain upright and win over weaker rivals.

Combat in *S. pullatus* lasted approximately one hour. Despite the long period of the ritual, bites or any application of physical damage to an opponent was not observed, and therefore the ritual may only result in an energy expenditure cost for the participating snakes. In one case (case #1), the males were not observed commencing a duel but the encounter did not result in combat. Instead, the dominant male chased the subordinate male away suggesting that the cost of energy expenditure, or perhaps even previous combat experience, may serve as a deciding factor for males during combat rituals. In two of the reported cases (case #1 and #2), three animals were present, two of which participated in the ritual and the third (female) observed to copulate with the likely winner of

the combat. It is possible that proximity of this nearby female may have incited combat ritual. Combat behaviour in snakes typically occurs during the mating season and is mostly related to copulation (Capula & Luiselli, 1997; Schuett et al., 2001; Almeida-Santos & Marques, 2002).

In both interactions of *Spilotes* in the southeast region on Cardoso Island, Sao Paulo, combat occurred during early spring, which is when the final period of copulation for *Spilotes* species in the southern hemisphere occurs (Muniz-Da-Silva, 2012). However, combats between male *Spilotes*, observed in the central-west region, occurred in late spring and early summer, which does not correspond to the mating season of the species. During these events, there were no females present. This may suggests that male-male combat rituals for *S. pullatus* may serve other purposes besides access to females such as dominance or territory dispute. Dominance and territory has also been suggested as a cause of combat for *Chironius bicarinatus* (Marques et al., 2009)

In one instance (case #3) exposure of the hemipenis of one of the snakes was observed during combat. Almeida-Santos et al. (1998) also observed this behaviour in *Micrurus frontalis*. Behavioural analysis of this phenomenon is not easily explained and would require further observations to decipher exact reason for its function.

ACKNOWLEDGEMENTS.

We thank R. Cogni, P. R. Guimarães Júnior, J. M. Longo, E. Ayer, R. M. Rodrigues, L. Pizzatto and C. R. Martins for their important photos, videos and information that were essential for elaboration of the manuscript. We also thank V. F. Czank for illustration in this paper and Fundação de Amparo à Pesquisa do Estado de São Paulo (2010/14733-1) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior for financial support. Suggestions for improvements to the original manuscript by Dr Todd Lewis greatly improved the final version.

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