

# Tail mock-strike and hemipenis display in the Coral snakes, genus *Micrurus* (Elapidae): epiphenomenon or deimatic behaviour?

HERBERT SERAFIM<sup>1</sup> and MARCELO RIBEIRO DUARTE<sup>2</sup>

<sup>1</sup>Depto. de Genética e Biologia Evolutiva, Instituto de Biociências, USP, CEP 05508-900, São Paulo, SP, Brazil. hserafim@usp.br

<sup>2</sup>Laboratório de Herpetologia, Instituto Butantan, São Paulo, SP, Brazil.  
mrduarte@butantan.gov.br [author for correspondence]

THE relationship between aposematic coloration and the consequential avoidance by predators has been established by multiple studies (Brodie Jr. & Brodie III, 1980; Brodie III, 1993; Buasso *et al.*, 2006). As an additional defensive strategy, tail display behaviours are widespread among most snake families, both in harmless species and dangerously venomous species (e.g. coral snakes, genus *Micrurus* - Greene, 1973; Wüster & Cox, 1992). It is often assumed that this behaviour can have survival value when the snake is attacked by a predator Greene (1973).

The coral snakes of the genus *Micrurus* are represented in Brazil by 24 species (SBH, 2008), and there are dozens of mimic species belonging to several genera Campbell & Lamar (2004). Some coral snakes, such as the subspecies of *Micrurus frontalis*, exhibit defensive tail display behaviour and will protrude one or the other hemipenis when handled violently or molested (Allen, 1940; Azevedo, 1960; Sazima & Abe, 1991; Roze, 1996). Among Brazilian coral snakes, only *M. corallinus* and *M. limbatus* do not use a defensive tail display (Roze, 1996). In this note we report on the tail display behaviour of *M. altirostris* (formerly *M. frontalis altirostris*) in a staged encounter in captivity and compare our observations with those of *M. frontalis* in the wild.

In the summer of 1999 an adult male *M. altirostris* (ca. 110 cm total length) from São Miguel D'Oeste, SC, southern Brazil, (26°43'S, 53°31'W, 645 m altitude) was sent to Instituto Butantan, São Paulo, southeastern Brazil. On its arrival, the snake was released on the ground (ca. 10:00 h) and immediately engaged in tail display behaviour. Despite the repetitive action of raising and curling its tail, hemipenis eversion did not occur regularly, and when this behaviour was observed the organ was extruded rapidly and only for a very brief period, even when stimulated gently with a stick (Figures 1A-B). Concomitantly, tail mock-strikes were sometimes observed after strong stimulation.

During fieldwork in Conceição do Mato Dentro, MG, southeastern Brazil (19°15'40"S, 43°31'58"W, 1.364 m altitude) an adult male *Micrurus frontalis* (ca. 100 cm total length) was found (12<sup>th</sup> December 2006 at 15:00 h in rocky fields - "campo rupestre"), in which and a rare form of hemipenis display behaviour was observed and photographed. When unintentionally approached, the snake exhibited defensive tail display behaviour including complete hemipenis eversion (Figure 2) lasting two minutes, and at least two more minutes when gently aggravated with a stick. Hemipenis eversion has been interpreted as an additional threat for predators (Allen, 1940; Azevedo, 1960; Roze, 1996) as well as deimatic behaviour (Allen, 1940), whereas Greene (1988) and Wüster & Cox (1992) suggest that this is probably an epiphenomenon of the tail display.

An interesting aspect of these recent observations is the fact that an applied stimulus resulted in very rapid and almost unnoticed hemipenis eversion in *M. altirostris*, and may adequately fit the hypothesis of epiphenomenon. Alternatively, the mock-strike and curled-over-the-back 'wagged' tail in this species (Figure 1C), as well as the resemblance of the defensive display to that of *Naja* species (elevation of the anterior portion of the body and formation of a "hood"), may reinforce the hypothesis that the tail display of one species might mimic the head or the tail of another, as proposed by Greene (1973). That a single human approach in the field resulted in hemipenis eversion for at least four minutes in *M. frontalis*, however, is more consistent with the hypothesis of deimatic behaviour, even if it can result in injury to one of the hemipenes by the potential predator.

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**Figure 1.** Defensive tail display in *Micrurus altirostris* from São Miguel D'Oeste, SC (26° 43'S, 53° 31'W, 645 m). Top: Defensive position after be gently stimulated by stick Note the head hidden under coils. Centre: Detail of the tail raising and curling, and subtle right hemipenis eversion. Bottom: Curled over the back and 'wagged' tail. Note the resemblance of this tail display behaviour with *Naja* defensive display (elevation of anterior portion of the body and formation of 'hood'). Photographs © H. Serafim and M. R Duarte.

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**Figure 2.** Top: Defensive tail display of *Micrurus frontalis* from Conceição do Mato Dentro, MG (19° 15' 40''S, 43° 31' 58''W, 1.364 m). Bottom: Close-up of everted hemipenis.

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