

Natural history of the coral snake *Micrurus decoratus* (Elapidae) from the Atlantic Forest in southeast Brazil, with comments on possible mimicry

Otavio A.V. Marques

Laboratório de Herpetologia, Instituto Butantan, Av. Vital Brazil 1500, 05503-900 São Paulo, SP, Brasil

Neotropical coral snakes are perhaps the most distinctive group among the whole elapid radiation, due to their bright color pattern, defensive behavior and feeding behavior (Greene, 1973; Roze, 1983; Sazima and Abe, 1991). The coral snake genus *Micrurus* is comprised of about 50 species (Campbell and Lamar, 1989), but data on the natural history and ecology of this group are restricted to a few species (Greene, 1973, 1976, 1984; Greene and Seib, 1983; Jackson and Franz, 1981; Solórzano and Cerdas, 1988; Marques, 1992, 1996; Marques and Sazima, 1997). The little-known *Micrurus decoratus* is restricted to the Atlantic Forest of southeast Brazil (Campbell and Lamar, 1989), and is rare in herpetological collections. I report here on distribution, body size, diet, reproduction and defensive tactics of this small coral snake, based on 55 specimens housed in the collection of the Instituto Butantan in São Paulo (IB) and a few captive individuals.

Distribution. *Micrurus decoratus* occurs exclusively in the Atlantic Forest of the Serra do Mar in southeast Brazil between 20 and 30°S, a distribution limit already recorded for this species (Campbell and Lamar, 1989). All specimens here examined were collected at localities above 700 m a.s.l. Similar data were obtained in other Brazilian collections (Museu de História Natural Capão da Imbuia and Museu Nacional) (J.C. Moura-Leite and D. Fernandes, pers. com.). Thus, the vertical distribution of *M. decoratus* extends from about 700 m to at least 1,500 m (see Campbell and Lamar, 1989).

Body size. Both the smallest adult males (with opaque efferent ducts and enlarged testes) and females (with vitellogenic follicles) measured 475 mm. Thus, based on the criteria of Shine (1978) for sexual maturity, males and females of *M. decoratus* attain maturity at comparable lengths, similar to males and females of *M. corallinus* (Marques, 1996). Mature males of *M. decoratus* averaged 541 mm ($s = 57$, $n = 20$) and the largest one reached 645 mm. Mature females averaged 516 mm ($s = 41$, $n = 6$) and the largest one reached 570 mm. Although there is no significant difference ($t = 1.00$, $df = 24$, $P = 0.32$) in the mean length, males seem to reach a larger body size than females. Greater male size is also observed in another coral snake species with a triad color pattern, *M. frontalis* (Roze, 1996), which shows ritual combat between males (Almeida-Santos, 1998). Male combat was never recorded among species of *Micrurus* with black rings arranged singly,

the females being always larger than males (e.g., *M. averyi*, *M. corallinus*, *M. fulvius* and *M. nigrocinctus*) (Jackson and Franz, 1981; Quinn, 1979; Vanzolini, 1985; Solórzano and Cerdas, 1988; Marques, 1996), which may indicate absence of ritual combat in this group of coral snakes. Presence or absence of male combat may be an additional characteristic that differentiates the groups of *Micrurus* recognized in the phylogeny elaborated by Slowinsky (1995). Information on sexual dimorphism and reproductive strategies for other species of coral snakes is thus needed for a better understanding of the evolution of this group of snakes.

Feeding. Of five prey found in the gut contents of the examined specimens ($n = 24$), three were caecilians and two were amphisbaenians. Thus, the diet of *M. decoratus* seems similar to that of the sympatric *M. corallinus* (Marques and Sazima, 1997). Two prey items (*Amphisbaena* sp. and *Siphonops* sp.) were ingested headfirst and one (*Siphonops* sp.) was eaten tail first. Tail first ingestion appears to be related to underground feeding, as *M. corallinus* swallows its prey headfirst when on surface (Marques and Sazima, 1997).

Reproduction. Only females collected in October ($n = 1$) and November ($n = 2$) contained vitellogenic follicles (>5 mm). Five females collected throughout the year had no vitellogenic follicles or eggs. The two smallest individuals (155 and 166 mm SVL, probably hatchlings) were collected in May. Thus, the reproductive cycle of *M. decoratus* seems similar to that of the sympatric *M. corallinus*, with vitellogenesis at the onset of the rainy season, oviposition in the middle of rainy season, and recruitment of juveniles at the end of the rainy season and early dry season (Marques, 1996).

Defensive behavior. The defensive behavior of *M. decoratus* is similar to that of other species of *Micrurus* (Sazima and Abe, 1991; Marques et al., 2001). Its defensive repertoire includes tail exhibition and dorso-ventral body flattening. All live *M. decoratus* examined ($n = 7$) showed a well pronounced tail-raising behavior, even when their bodies were touched gently, a behavior also recorded for *M. frontalis* and *M. lemniscatus*, but not for *M. corallinus*. In the latter species, this behavior is clearly less pronounced, and many captive individuals do not display it at all (those that do display, do so only when rigorously prodded, Marques, 1992).

Color pattern and mimicry. *Micrurus decoratus* has a triad coral pattern (TT according to Savage and Slowinsky, 1992). The width of the external rings of the triads is quite variable between individuals, although these are almost always narrower than the central ring. In two individuals (IB1456 and 43005), the external rings are extremely reduced on the dorsal region and absent on the ventral region. *Micrurus decoratus* is a venomous snake and its color pattern may be regarded as a warning signal to predators. This coral snake is one of the few species of the genus that has triads with reduction of the external rings (Campbell and Lamar, 1989) and the polymorphism in its color pattern (variable width of the external rings) indicates the existence of a mimetic relationship with other *Micrurus* species. Throughout its range, *M. decoratus* is sympatric with *M. corallinus*

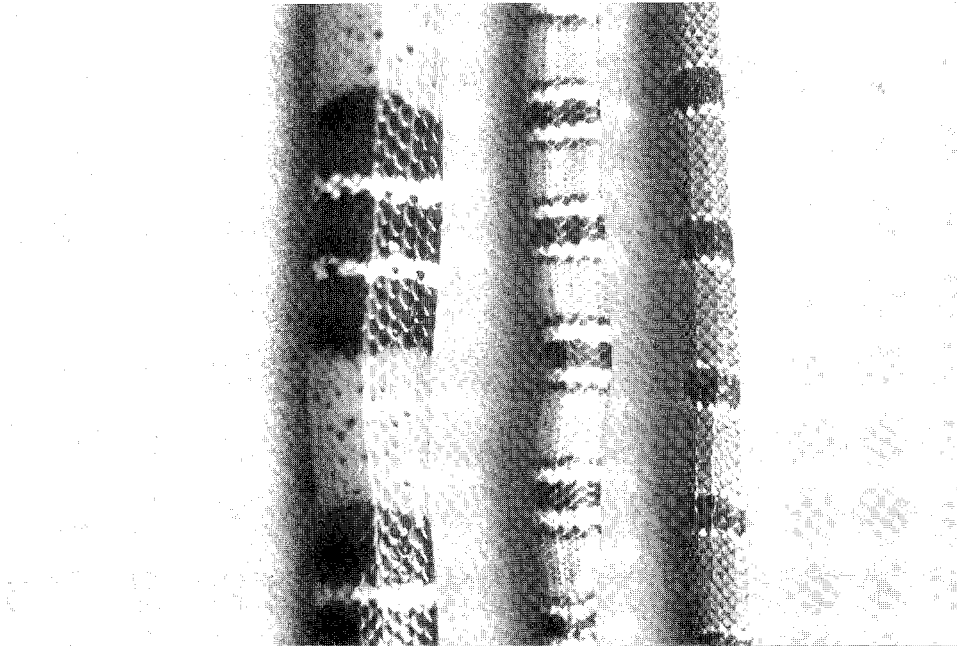


Figure 1. *Micrurus lemniscatus* with similar width in black rings (left), *M. decoratus* with narrow external rings (center); note similarity to the supposed model *M. corallinus* (right) (Photo by G. Puerto).

(Campbell and Lamar, 1989; Marques, 1992). This latter species has black rings arranged singly, and is very abundant and easy to find throughout the Serra do Mar range (Marques, 1992; Marques et al., 2001). Within this area *M. corallinus* probably is a mimetic model for some colubrid species, mainly *Erythrolamprus aesculapii* (Marques and Puerto, 1991; Marques, 1992). Individuals of *M. decoratus* with very narrow external rings are similar to *M. corallinus* (fig. 1), and I suggest that the latter species is a mimetic model for *M. decoratus*. Two reasons may be invoked for the suggested mimetic convergence: *M. decoratus* seems to be less abundant than *M. corallinus* throughout its distribution, and *M. decoratus* has a very small head and mouth and thus its bite might be less effective than that of the model *M. corallinus*. In spite of the two snakes being highly venomous, these factors would favor a mimetic convergence between them. Mullerian mimicry has been attributed to some snakes of the genus *Micrurus* (Greene and McDiarmid, 1981; Roze, 1983), although the likeness among certain sympatric species is probably due to common ancestry rather than to convergent mimicry (cf. Pough, 1988). Nevertheless, the supposed mimetic relationship between *M. decoratus* and *M. corallinus* (which belong to two distinct phylogenetic lineages with different color pattern — see Slowinsky, 1995) and a few Amazonian species (Roze, 1983) possibly are due to mimetic convergence.

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