

DIET AND FEEDING BEHAVIOR OF THE CORAL SNAKE, *MICRURUS CORALLINUS*, FROM THE ATLANTIC FOREST OF BRAZIL

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Coral snakes of the elapid genus *Micrurus* comprise about 50 species distributed from the southern United States to central Argentina (Campbell and Lamar 1989). These snakes feed on elongate prey including snakes, lizards, and amphisbaenians (Cunha and Nascimento 1978; Greene 1984; Roze 1983; Sazima and Abe 1991). However, only the North American species *Micrurus fulvius* has been studied in detail (Greene 1984; Jackson and Franz 1981).

Here we report on the diet and feeding behavior of *M. corallinus*, a snake widespread in the Atlantic forest in eastern Brazil (Campbell and Lamar 1989). Previous information on this snake is limited to general and unsubstantiated comments on prey (Amaral 1977; Roze 1983), a record of one adult with *Amphisbaena* sp. in its gut (Lema et al. 1983), and an observation on captive specimens fed with European lizards (Mertens 1927).

We dissected 512 museum specimens of *Micrurus corallinus* from several localities throughout its range in eastern Brazil (see map in Campbell and Lamar 1989) in the Atlantic forest from Bahia to Santa Catarina (18°10'–27°20'S), including a large sample ($n = 48$) from coastal São Paulo (23°20'–25°05'S). For each snake, we recorded the snout–vent length (SVL) and orientation of prey item in the gut (cf. Greene 1984). The identity and total length (TL) of each prey item was recorded; for partly digested prey, we estimated length by comparison with intact reference specimens.

We recorded 16 feeding sequences for three captive specimens (55–75 cm SVL) from São Paulo. The snakes were individually housed in 52 × 27 × 20 cm

terraria with 10–15 cm deep soil substrate, a piece of bark or trunk for cover, and a water bowl (Marques 1992). We offered live or dead amphisbaenians, *Leposternum microcephalum* and the snakes *Atractus* sp., *Liophis miliaris*, and *Sibynomorphus neuwiedi* as prey. Ratios of prey TL to predator SVL (Pough and Groves 1983) varied from 0.36–0.62. Live prey was released about 10–20 cm from the captive snakes (cf. Greene 1984); mechanically killed prey was also placed 10–20 cm from the snake and left unmoved in order to test whether the coral snake would feed on dead and immobile prey. One video-recorded and one photographed sequence of *Micrurus corallinus* feeding on *Leposternon* prey in nature were also used in our data. Voucher specimens of snakes and their prey are housed in the collections of the Instituto Butantan (IB), Museu de História Natural “Capão da Imbuia” (MHNCI), Museu Nacional do Rio de Janeiro (MNRJ), and the Museu de História Natural da Universidade Estadual de Campinas (ZUEC).

Ninety-three of 512 museum specimens of *Micrurus corallinus* contained identifiable prey in their guts. Amphisbaenians were the most common prey of *M. corallinus* (Table 1) as seems to be true for other species of *Micrurus* in the neotropics (Cunha and Nascimento 1978; Greene 1973; Roze 1983; Sazima and Abe 1991), but data on proportion of amphisbaenians relative to other prey types are lacking for these. The amphisbaenian *Rhineura floridana* represents about 9% of prey items of *M. fulvius* from Florida (Greene 1984).

Leposternon microcephalum, the most frequent prey species in the diet of *Micrurus corallinus*, is the

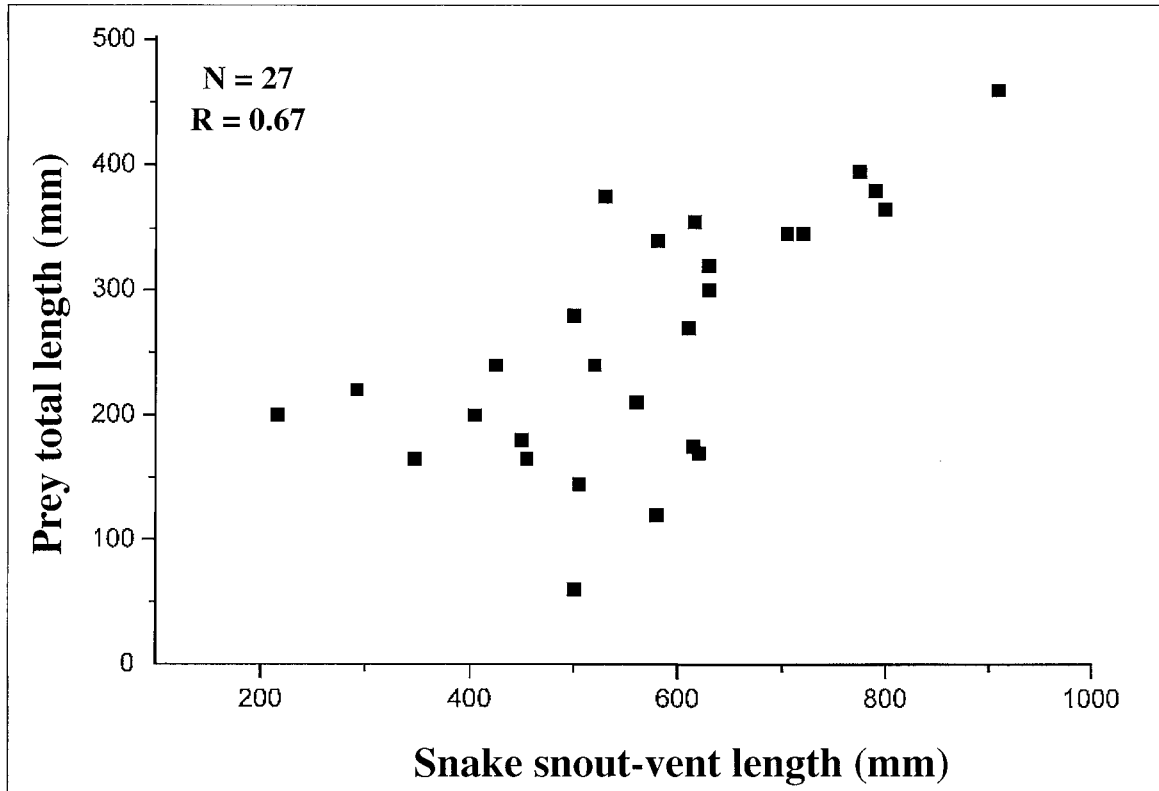


Figure 1. Relationship between snout-vent length of *Micrurus corallinus* and total length of its prey in the coastal Atlantic forests of eastern Brazil.

most common amphisbaenian in the coastal Atlantic forest (Vanzolini 1951; pers. obs.). For another coastal amphisbaenian, *L. wuchereri*, Zamprogno and Sazima (1993) found 34 individuals in an area of 1500 m², which is the highest density known for any neotropical amphisbaenian. On the same occasion, three individuals of *Amphisbaena* sp., one individual of the subterranean snake *Elapomorphus wuchereri*, and one specimen of *M. corallinus* were found (Zamprogno and Sazima 1993; IS, pers. obs.).

Caecilians, a prey type represented by about 10% (Table 1) increased to about 30% in the subset of the 27 least digested prey items from our sample (Marques 1992). This percentage difference probably results from the fact that caecilians leave few, if any, identifiable remains after digestion, whereas amphisbaenians leave at least part of their undigested skin. Thus, caecilians may be underrepresented in our study, and in the gut content analyses of neotropical *Micrurus* in general.

The lizard prey of *Micrurus corallinus* were all cryptozoic species (litter inhabitants), except for those of the genus *Mabuya* (terrestrial or arboreal); the typhlopoid snakes found were fossorial. Of 52 amphisbaenians, 40% were ingested tail first. This tendency, also found in caecilian prey ($n = 9$), may be related to underground feeding, since *M. corallinus* swallows its prey head first when feeding in the surface (see below). Ventral scale overlap is used as a cue by ophiophagous snakes (Greene 1976), but since scales of amphisbaenians do not overlap, *M. corallinus* must rely on other cues, probably olfactory, to locate the head of this prey type. Prey orientation was head first for lizards ($n = 4$) and colubrid snakes ($n = 2$), both prey types with overlapping scales.

Prey TL was positively correlated with snake SVL (Fig. 1). Prey size for *Micrurus corallinus* was variable, 21–93% of snake SVL (Marques 1992), the largest individuals possibly selecting large prey as we found no small prey eaten by large snakes (Fig. 1; see

Table 1. Prey items from gut contents of *Micrurus corallinus* in the Atlantic forest of eastern Brazil. Ninety-four prey items were found in 93 snakes containing prey. The number of prey items (n) of a certain type is provided with prey frequency in parentheses.

| Prey type | n | (%) |
|---------------------------------------|-----|--------|
| Caecilians | | |
| unidentified (? <i>Siphonops</i> sp.) | 9 | (9.6) |
| Amphisbaenians | | |
| <i>Amphisbaena dubia</i> | 2 | (2.1) |
| <i>Amphisbaena</i> sp. | 11 | (11.7) |
| <i>Cercolophia roberti</i> | 1 | (1.1) |
| <i>Leposternon microcephalum</i> | 48 | (51.1) |
| <i>L. wuchereri</i> | 1 | (1.1) |
| <i>Leposternon</i> sp. | 1 | (1.1) |
| unidentified | 1 | (1.1) |
| Lizards | | |
| <i>Ophiodes</i> sp. | 4 | (4.2) |
| <i>Pantodactylus</i> sp. | 3 | (3.2) |
| <i>Mabuya</i> sp. | 3 | (3.2) |
| unidentified gymnophthalmids | 2 | (2.1) |
| Snakes | | |
| <i>Liotyphlops</i> cf. <i>wilderi</i> | 1 | (1.1) |
| <i>Typhlops brongersmianus</i> | 1 | (1.1) |
| unidentified typhlopid | 1 | (1.1) |
| <i>Xenodon neuwiedii</i> | 1 | (1.1) |
| unidentified colubrids | 4 | (4.2) |

Arnold [1993] and Shine [1991] for discussions of prey vs. snake size).

Amphisbaenid prey was seized, bitten, and released by *Micrurus corallinus* in all feeding sequences on the surface ($n = 8$). Later, the already dead prey was relocated and swallowed (Fig. 2). Greene (1973) suggested that prey release is advantageous for snakes feeding on amphisbaenians, since this prey type is able to inflict a powerful bite. However, *Leposternon* does not bite and displays a limited antipredatory repertoire, including simple escape movements and cloacal discharge with foul odor. Both of these responses are apparently ineffective against specialized predators such as coral snakes (Zamprogno and Sazima 1993; pers. obs.). Thus, the bite-release tactic may have evolved within a biting-prey context and persists in the handling of *Leposternon* prey. We additionally hypothesize that the muscular strength (Gans 1974)

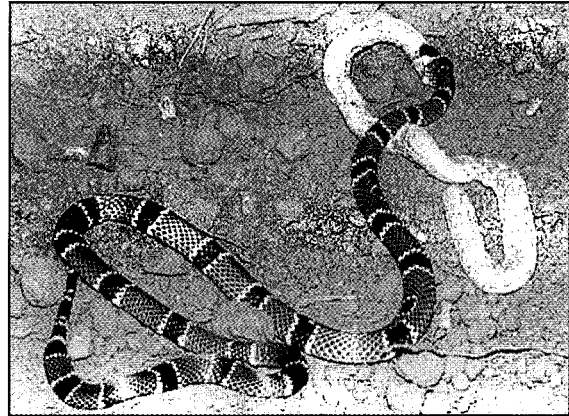


Figure 2. Captive *Micrurus corallinus* swallowing a dead amphisbaenian, *Leposternon microcephalum*, head first. The snake relocated the prey after it was bitten and released. Photograph by G. Puerto.

of a struggling amphisbaenian may also make the release of this prey type a better strategy.

Snakes were held by *Micrurus corallinus* until immobilized ($n = 8$), a behavior recorded for *M. fulvius* (Greene 1984) and probably found in other *Micrurus* species as well (Roze 1983). We suggest that behavioral differences for handling of snakes and amphisbaenians may also be related to differing escape abilities of the prey. An amphisbaenian is much slower and could crawl only over short distances, thus being easier to relocate than a snake.

Underground feeding was recorded once for a captive *Micrurus corallinus* preying on *Leposternon microcephalum*. The hole made by the prey was located by the snake in the course of its characteristic poking behavior during foraging (see Greene 1984). The prey was caught underground, held tail first and dragged to the surface where it was also swallowed tail first. Three additional instances of presumed subterranean feeding were recorded in nature. In all cases, *M. corallinus* was found on the forest floor swallowing a *Leposternon* prey whose body was partly underground (Marques 1992; F. M. Teixeira, pers. comm.).

Dead amphisbaenian prey (killed 12 h earlier) were located and ingested by captive *Micrurus corallinus*. Dead prey was refused by *M. fulvius* until moved by the observer (Greene 1984), which may indicate differences in prey perception between *M. fulvius* and

M. corallinus. In a study of necrophagy among neotropical snakes, Sazima and Strüssmann (1990) regarded *M. surinamensis* as a potential carrion feeder, a habit which may be found among other species within the genus as well.

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