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A rotten choice: feeding attempt by a coral snake (*Micrurus frontalis*) on a dead pitviper (*Bothrops jararaca*) that had swallowed a bulky rodent

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Carrion-eating is reported for about 40 snake species from five families (DeVault and Krochmal, 2002; Otto and Miller, 2004; Sasa et al., 2009; Platt and Rainwater, 2011) and scavenging behaviour may be a common trait in this group of squamate reptiles (DeVault and Krochmal, 2002). Some snake species purposely search for and consume dead prey (e.g., Capula et al., 1997) but most appear to be opportunistic scavengers that feed on carrion found during foraging or other movements (Savidge, 1988; Sazima and Strüssmann, 1990; Shivik and Clark, 1997; DeVault and Krochmal, 2002). The paucity of reports featuring necrophagy in snakes can most likely be attributed to the low frequency of encounters with these animals in the field, and with occurrences mostly in tropical regions (DeVault and Krochmal, 2002), where carrion is quickly dispatched by several other necrophagous animals (Sazima and Strüssman, 1990; DeVault et al., 2003). The tropics have the highest species richness of snakes in the world, but only around 20% of field records of necrophagy by snakes come from this region (DeVault and Krochmal, 2002).

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Among neotropical snakes, occasional necrophagy is reported for four species of aquatic dipsadids and a terrestrial viperid (Sazima and Strüssmann, 1990). The fossorial elapid coral snakes of the genus *Micrurus* Wagler, 1824 accept dead prey in captivity (Greene, 1984; Marques and Sazima, 1997), but consumption of dead prey in nature has remained uncertain for coral snakes. Here we report on an instance of carrion-eating by the southern coral snake, *Micrurus frontalis* (Duméril, Bibron & Duméril, 1854), which was found swallowing a dead and partly rotting jararaca pitviper, *Bothrops jararaca* (Wied, 1824) under natural conditions.

Field data were obtained by PAB, who documented the event photographically and collected the rotting pitviper for future analyses. The photos are housed at the Laboratório de Ecologia e Evolução, Instituto Butantan, and the pitviper is housed at the Coleção Herpetológica do Instituto Butantan (access number IB 89015). The total length of the coral snake was estimated against the dead pitviper, whose length was measured in the laboratory. Sex was determined by visual examination of the tail area (males have thicker tails than females, see Roze, 1996). The weight of the coral snake was obtained from a specimen of similar length, whereas weights of the dead pitviper and its rodent prey were obtained directly from the specimens.

A male *Micrurus frontalis* (total length, TL ca. 100 cm, weight ca. 200 g) was found at 1000 h on 1 November 2016 at the edge of a road crossing a forested area (22.9634°S, 46.554°W, elevation 887 m) in Bragança Paulista, São Paulo State, southeastern Brazil. The snake was found on the ground with a rotting, partially ingested *Bothrops jararaca* (TL = 59.8 cm, weight = 65 g) protruding from its mouth (Fig. 1A). The coral snake was in the process of swallowing the pitviper headfirst, but it stopped at a distended portion of the rotting carcass. The bulge in the pitviper had broken open to expose a

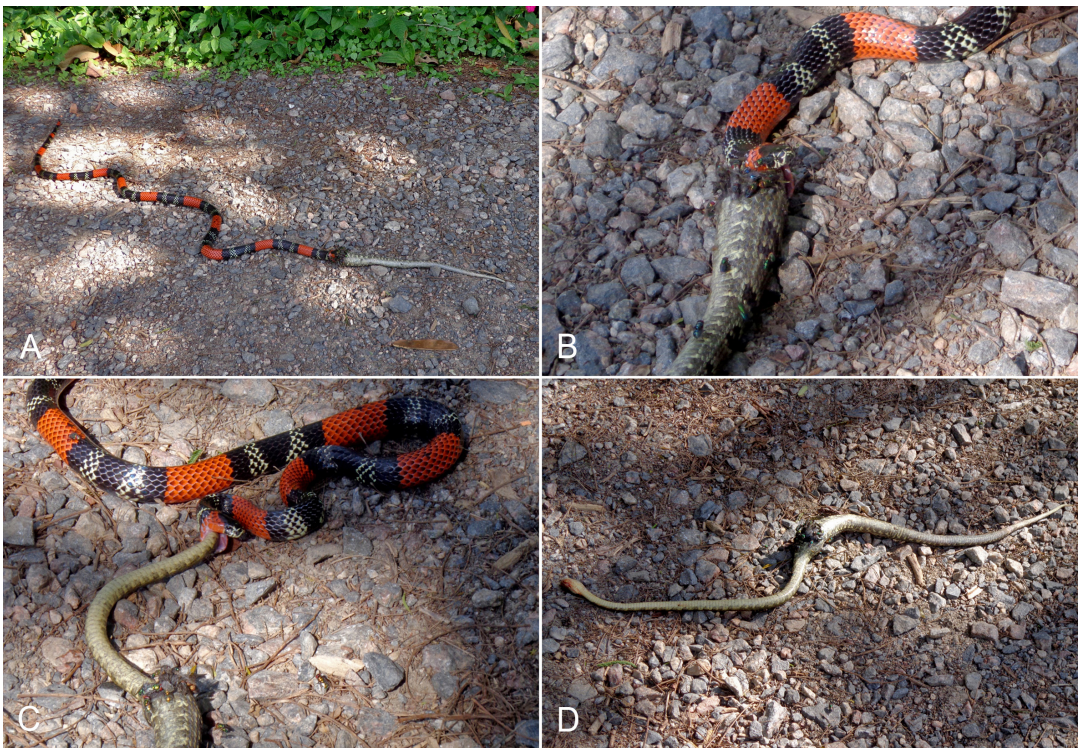

Figure 1. A coral snake (*Micrurus frontalis*) attempting to ingest a rotting pitviper (*Bothrops jararaca*) that swallowed a house mouse. When encountered, the coral snake had swallowed most of the dead pitviper (A), but was unable to proceed due to the bulge caused by the mouse inside the pitviper. Note bottle and flesh flies swarming on the partly exposed rodent and on the coral snake's head (B). After several attempts, the coral snake began to regurgitate the pitviper's carcass (C). The regurgitated pitviper with bottle and flesh flies swarming on the rotting mouse prey (D).

partially digested rodent, which had attracted bottle and flesh flies (Fig. 1B–D). After several unsuccessful attempts to continue swallowing the carcass, the coral snake regurgitated it (Fig. 1C). The regurgitated pitviper (Fig. 1D) had a house mouse, *Mus musculus* Linnaeus, 1758 (TL = 17.3 cm, weight = 28 g) in its stomach. The prey/predator mass ratio for the coral snake was 0.32, and for the pitviper 0.43.

The coral snake likely regurgitated the pitviper because it was unable to pass the bulge caused by the rodent. Snakes of the genus *Micrurus* have a relatively small gape and elapids in general display a feeding mechanism called the palate-erector prey transport (Deufel and Cundall, 2003). The combination of small gape and feeding mechanism appears to have prevented complete ingestion of the pitviper once the coral snake reached the bulge of the carcass. Were not for this bulge, the pitviper would likely have been ingested entirely, as the coral snake could easily accommodate the prey mass and length within its stomach (Cundall and Greene, 2000).

Carcasses are an advantageous food for both opportunistic and habitual carrion feeders, as this type of "prey" does not defend against a predatory attack (Sazima and Strüssmann, 1990; DeVault and Krochmal, 2002) and can be consumed with no risk other than that imposed by the presence of other carrion eaters. The coral snake *M. frontalis* and other species of the genus usually bite and hold their prey (Greene, 1973; Marques and Sazima, 1997; pers. obs) and, thus, non-retaliating prey is advantageous. Still, freshly dead prey is usually refused by captive *Micrurus* snakes until moved by the observer (Greene, 1976) but immobile dead prey was accepted by at least one species, *M. corallinus* (Merrem, 1820) (Marques and Sazima, 1997). *Micrurus surinamensis* (Cuvier, 1817) was regarded by Sazima and Strüssmann (1990) as a potential carrion-feeder due to its aquatic habit (see below).

Most records of scavenging are found among aquatic and semi-aquatic snakes, other than pitvipers, which rely on chemical cues for prey detection, as predicted by Sazima and Strüssmann (1990) and confirmed by DeVault and Krochmal (2002). Coral snakes of the genus *Micrurus* have fossorial and/or cryptozoic habits and small eyes (Roze, 1996). Thus, vision likely has little value in foraging and these snakes have to rely heavily on chemosensory prey detection (Greene, 1973). Hence, our record may be an indication that carrion-eating is more widespread in the genus *Micrurus* than previously known. We are unaware of any other reports of scavenging by fossorial and/or cryptozoic snakes, but we regard them as potential carrion-eaters, since they rely mostly on chemosensory information to locate their food.

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