



PREDATION OF *Scolopendra viridicornis* (NEWPORT 1844) (CHILOPODA, SCOLOPENDRIDAE) BY *Bothrops erythromelas* (AMARAL 1923) (SQUAMATA, VIPERIDAE) IN THE CAATINGA, NORTHEAST BRAZIL

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Abstract: *Bothrops erythromelas* is a terrestrial Viperidae snake that feeds mainly on small lizards, anurans and mammals. *Scolopendra viridicornis* is a highly venomous centipede with a strictly carnivorous diet, feeding on invertebrates and even small vertebrates. On March 1th, 2016, during a herpetological survey we observed a subadult male *B. erythromelas* road-killed with a dead centipede popping out from its body. We believe that the centipede was ingested by the snake, and broke out through the snake's body when it was run over. Our report is the first predation record between these two venomous species.

Keywords: centipede; diet; roadkill; snake; venomous.

The pit vipers genus *Bothrops* belongs to Viperidae, a family of snakes widely distributed in the Americas (Campbell & Lamar 2004). Their diet is generalist, composed mainly of lizards, small mammals, anurans, besides other snakes, birds and centipedes (Martins *et al.* 2002). Some species can display ontogenetic diet shift, meaning that the snakes shift prey type as they grow (Andrade & Abe, 1999). In some cases, adults prey more frequently upon mammals (endotherms), whereas juveniles prey mostly upon ectotherms, such as centipedes (Silva *et al.* 2017). Nevertheless, regarding young individuals' diet, literature lacks

information on *Bothrops* consuming venomous Chilopoda, especially at species level (Silva *et al.* 2017).

Bothrops erythromelas (Amaral 1923) is a small-sized Viperidae species, popularly known as Caatinga lancehead (*jararaca-do-Sertão* in Brazilian Portuguese), widely distributed in the Caatinga biome, with marginal distribution in the Cerrado and Brazilian Atlantic Forest biomes (Nogueira *et al.* 2019). Hence, this species has already been recorded in the states of Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and Sergipe (Costa & Bérnils 2018,

Nogueira *et al.* 2019). It is nocturnal and terrestrial, inhabiting arid and semi-arid environments that surround dry and deciduous fragments of Tropical Forest, rocky areas, undergrowth of bromeliads and areas along river banks (Campbell & Lamar 1989, Martins *et al.* 2002, Lira-da-Silva *et al.* 2009, Nogueira *et al.* 2019). Belonging to the *B. neuwiedi* clade (Carrasco *et al.* 2019), *B. erythromelas* is a diet generalist, feeding mainly on small lizards, anurans, centipedes, and mammals (Martins *et al.* 2002), and it is noticeable that its venom is hemorrhagic, coagulant, and proteolytic (Silva *et al.* 2003).

Chilopoda, popularly known as centipedes, is an Arthropoda class widely distributed among all the continents, except for Antarctica (Moura *et al.* 2015). They are nocturnal terrestrial, and usually venomous arthropods, that inhabit humid substrates where they can hide at daylight and forage at nighttime. With a strictly carnivorous diet, they feed mainly on insects and other invertebrates. Nevertheless, some species can occasionally be opportunistic and feed on larger prey, i.e., vertebrates such as frogs, rats, snakes and bats (Molinari *et al.* 2005, Edgecombe & Giribet 2007, Moura *et al.* 2015).

The Order Scolopendromorpha, which includes *Scolopendra* (Linnaeus 1758), is the most aggressive and most voracious predator among the centipedes (Edgecombe & Giribet 2007), in which several species are of medical importance (Malta *et al.* 2008). As they use their claws to kill the prey, injecting the venom and later crushing their corpse with their forcipules, they are truly a risky choice of meal (Ruppert & Barnes 1994, Hickman *et al.* 1997, Molinari *et al.* 2005). *Scolopendra viridicornis* (Newport 1844) is a widespread South American Scolopendromorpha, widely distributed in Brazil, popularly known as Amazonian Giant centipede worldwide (*lacraia* in Brazilian Portuguese). Comparing toxic activities found in venoms of three species of Brazilian centipedes (*Otostigmus pradoi* Bücherl 1939, *Cryptops iheringi* Brölemann 1902 and *S. viridicornis*), *S. viridicornis* had the most toxic venom, being able to induce a highly severe envenomation, causing edema and myotoxicity (Malta *et al.* 2008).

During a herpetological survey carried out in the Caatinga on March 1th, 2016, a subadult male specimen of *B. erythromelas* (SVL 380 mm; tail

length 24.5 mm) was found road-killed (Figure 1a) on a secondary unpaved road, adjacent to highway BA-046, in the municipality of Ipupiara, state of Bahia, northeastern Brazil (11°49'48.95" S, 42°31'36.40" W, datum SIRGAS2000; 837 m a.s.l.). It was noticed that a dead centipede was protruding through the body wall of the left side of the snake (Figure 1b). Both specimens were collected and deposited together, under the voucher MBML 3538, in Zoological Collection of Museu de Biologia Prof. Mello Leitão, Instituto Nacional da Mata Atlântica, municipality of Santa Teresa, state of Espírito Santo, southeastern Brazil. Analysis of the stomach contents of *B. erythromelas* evidenced an adult individual of the poisonous centipede *Scolopendra viridicornis* (Figure 1c and d). The centipede species and its age class were confirmed by a specialist, Prof. Amazonas Chagas Junior, from Universidade Federal de Mato Grosso (UFMT), state of Mato Grosso, Brazil.

It is not possible to determine whether *S. viridicornis* had killed the snake after ingestion and was breaking out through the snake when they were run over or if they were road-killed together, and the car tire pressure blew the snake exposing the centipede. However, we believe in the first hypothesis, since no other parts (as muscles, bones or viscera) of the snake were exposed due to the opening in the snake's body that relieved the pressure. Arsovski *et al.* (2014) reported a similar event with two European species, where a nose-horned viper *Vipera ammodytes* (Linnaeus, 1758) was found with a *Scolopendra cingulata* Latreille, 1829 protruding through its abdomen, both also dead. They also could not determine how the two individuals deceased, but did not dismiss the possibility of the centipede has broken – by eating – its way out through the snake.

Our report is one of the few works that deals with prey items of *Bothrops* at species level, being the first of the Caatinga lancehead pit viper *Bothrops erythromelas* preying upon the centipede *Scolopendra viridicornis*. Martins *et al.* (2002) state that ontogenetic diet shifts occur in all generalist species of *Bothrops*. However, ontogenetic diet shifts do not occur in the small-bodied *B. erythromelas* Amaral, 1923, *B. itapetiningae* (Boulenger, 1907), and *B. mattogrossensis* Amaral, 1925. Our record in specimen, which is not confirmedly and adult, but, suits as one

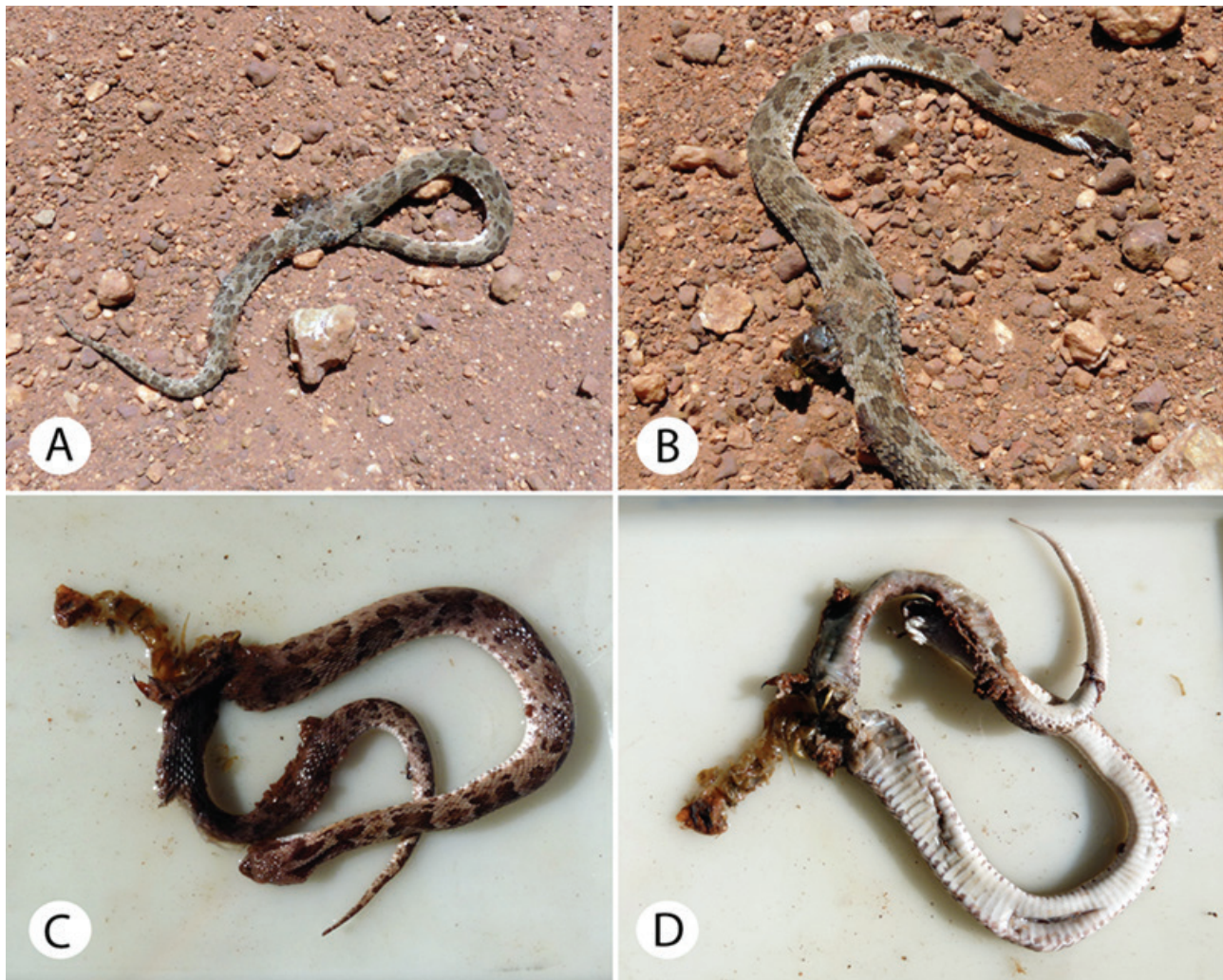


Figure 1. Specimen of an adult individual of the Caatinga lancehead *Bothrops erythromelas* evidencing the ingested Giant centipede *Scolopendra viridicornis*. A. Specimens found run over; B. part of the centipede coming out of the snake's body; C–D. the partially digested *Scolopendra viridicornis* being removed from the snake in dorsal and ventral views, respectively.

more evidence that *B. erythromelas* maintain its diet on centipede even when in older life stages. Moreover, although phylogenetic reconstruction of ontogenetic diet shifts indicates that this character was lost at least once in the *B. neuwiedi* group, one of the reasons for such absence may be subsampling (Martins *et al.* 2002).

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REFERENCES

- Andrade, D. V. & Abe, A. S. 1999. Relationship of venom ontogeny and diet in *Bothrops*. *Herpetologica*, 55: 200–204.
- Arsovski, D., Ajtic, R., Golubovic, A., Trajceska, I., Dordevic, S., Anelkovic, M., & Tomovic, L. 2014. Two fangs good, a hundred legs better: juvenile viper devoured by an adult centipede it had ingested. *Ecologica Montenegrina*. 1(1), 6–8.
- Campbell, J.A., & Lamar, W.W. 1989. The venomous reptiles of Latin America.
- Carrasco, P. A., Grazziotin, F. G., Farfan, R. S. C., Koch, C., Ochoa, J. A., Scrocchi Manfrini, G. J., &

- Chaparro, J. C. 2019. A new species of *Bothrops* (Serpentes: Viperidae: Crotalinae) from Pampas del Heath, southeastern Peru, with comments on the systematics of the *Bothrops neuwiedi* species group. *Zootaxa* 4565 (3), 301–344.
- Costa, H. C. & Bérnils, R. S. 2018. Répteis do Brasil e suas Unidades Federativas: Lista de espécies. *Herpetologia Brasileira*, 8(1), 11–57.
- Edgecombe, G. D. & Giribet, G. 2007. Evolutionary Biology of Centipedes (Myriapoda: Chilopoda). *Annual Review of Entomology*, 52, 151–170. DOI: 10.1146/annurev.ento.52.110405.091326
- Hickman, C., Roberts, L. & Larson, A. 1997. *Integrated Principles of Zoology*. Dubuque, IA, USA, Wm. C. Brown Publishers. p. 912.
- Lira-da-Silva, R. M., Mise, Y. F., Casais-e-Silva, L. L., Ulloa, J., Hamdan, B., & Brazil, T. K. 2009. Serpentes de importância médica do nordeste do Brasil. *Gazeta Médica da Bahia*, 79 (1), 7–20.
- Malta, M.B., Lira, M.S., Soares, S.L., Rocha, G.C., Knysak, I., Martins, R., Guizze, S.P.G., Santoro, M.L. & Barbaro, K.C. 2008. Toxic activities of Brazilian centipede venoms. *Toxicon* 52, 255–263. DOI: 10.1016/j.toxicon.2008.05.012
- Martins, M., Marques, O. A., & Sazima, I. V. A. N. 2002. Ecological and phylogenetic correlates of feeding habits in Neotropical pitvipers of the genus *Bothrops*. *Biology of the Vipers*, 307–328.
- Molinari, J., Gutiérrez, E. E., Ascensão, A. A., Nassar, J. M., Arends, A. & Márquez, R. J. 2005. Predation by giant centipedes, *Scolopendra gigantea*, on three species of bats in a venezuelan cave. *Caribbean Journal of Science* 41, 340–346.
- Mora-Obando, D., Salazar-Valenzuela, D., Pla, D., Lomonte, B., Guerrero-Vargas, J. A., Ayerbe, S., & Calvete, J. J. 2020. Venom variation in *Bothrops asper* lineages from north-western South America. *Journal of Proteomics*, 229, 103945.
- Moura, L. O. G., Machado, C. M. S., Conceição, B. M., Silva, A. O., Santana, A. F., & Faria, R. G. 2015. Predation of *Ameivulla ocellifera* (Teiidae) by (Scolopendridae: *Scolopendra* sp.) in the vegetation of the Caatinga biome, northeastern Brazil. *Herpetology Notes*, 8, 389–391. DOI: 10.1590/1676-0611-BN-2020-1137
- Nogueira, C. C., Argôlo, A. J., Arzamendia, V., Azevedo, J. A., Barbo, F. E., Bérnils, R. S. & Martins, M. 2019. Atlas of Brazilian snakes: verified point-locality maps to mitigate the Wallacean shortfall in a megadiverse snake fauna. *South American Journal of Herpetology*, 14(sp1), 1–274.
- Ruppert, E. & Barnes, R. 1994. *Invertebrate Zoology*. New York, USA, Saunders College Publishing. p. 1056.
- Silva, K.M.P.D., Almeida-Santos, S.M.D., & Bertani, R. 2017. Hundred legs good, two fangs better: adult centipede (Scolopendridae) devoured by a juvenile Amazon lancehead, *Bothrops atrox* (Viperidae). *Acta Amazonica*, 47(2), 171–174. DOI: 10.1590/1809-4392201601884
- Silva, M. B., Schattner, M., Ramos, C. R., Junqueira-de-Azevedo, I. L., Guarnieri, M. C., Lazzari, M. A., Sampaio, C. A. M., Pozner, R. G., Ventura, J. S., Ho, P. L., and Chudzinski-Tavassi, A. M. 2003. A prothrombin activator from *Bothrops erythromelas* (jararaca-da-seca) snake venom: characterization and molecular cloning. *Biochemical Journal*, 369(1), 129–139.
- Venegas, P. J., Chávez-Arribasplata, J. C., Almora, E., Grilli, P. G., & Duran, V. 2019. New observations on diet of the South American two-striped forest-pitviper *Bothrops bilineatus smaragdinus* (Hoge, 1966). *Cuadernos de Herpetología*, 33 (1), 29–31.

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