

of the head. The back is also covered by dark brown longitudinal bands, outlined in yellow, which do not form the characteristic horseshoe markings of the species, but are instead fused, forming irregular stripes (Fig. 1D, F). While individuals with atypical coloration patterns have been recorded in many snake species, particularly vipers, there are still relatively few reports for the genus *Bothrops*, in comparison with other viper genera (Gloyd 1935. Pap. Michigan Acad. Sci. 20:661–668). The anomalous coloration pattern observed in the *B. alternatus* described here does not appear to have represented an adaptive disadvantage for the individual, given that it was able to reach adulthood.

ALYSSA FREITAS DE ALMEIDA (e-mail: alyssafalmeida@gmail.com), **ANA CAROLINA MARTINS DOS SANTOS** (e-mail: annamartins273@gmail.com) and **MATHEUS CRAVO**, Instituto da Saúde, Universidade de Passo Fundo, CEP 99001-970, Passo Fundo, Rio Grande do Sul, Brazil (e-mail: matheuscravo51@gmail.com); **NOELI ZANELLA**, Programa de Pós-Graduação em Ciências Ambientais, Universidade de Passo Fundo, CEP 99001-970, Passo Fundo, Rio Grande do Sul, Brazil (e-mail: zanella@upf.br).

BOTHROPS ASPER (Fer-de-lance). DIET. *Bothrops asper* is a neotropical viperid renowned for its high venom yield and the hemorrhagic and necrotic effects on tissues following envenomation (Gutiérrez et al. 1998. Toxicon 36:1529–1538). Distributed throughout southern Mexico, Central America, and northern South America, *B. asper* can be found from sea level to above 2000 m elevation (Pérez-Santos and Moreno 1986. Rev. Españ. Herp. 1:9–27) and is associated with a variety of lowland and forest habitats. The species is considered an opportunistic predator (Sasa et al. 2009. Toxicon 54:904–922), with previous studies documenting a diversity of prey species, including arthropods, birds, mammals, reptiles, and amphibians (Boada et al. 2005. Herpetozoa 18:77–79; Sasa et al. 2009, *op. cit.*; Vela et al. 2020. Reptil. Amphib. 27:422–425; Toszeghi et al. 2022. Herpetol. Notes 15:307–309; Loaiza-Lange et al. 2023. PeerJ 11:e14817). Among the documented amphibian prey, most recorded species were anurans (Sasa et al. 2009, *op. cit.*). However, overall, amphibians may constitute only a small proportion of the diet of *B. asper* and are probably mostly consumed by juvenile snakes, reflecting an ontogenetic shift in diet (Sasa et al. 2009, *op. cit.*).

At 1130 h on 27 November 2022, we (CL, SML) encountered a juvenile *B. asper* on a stream side near El Cope, Panama (8.6283°N, 80.5841°W; WGS 84; 298 m elev.). The snake was ca. 39 cm long and positioned on a rock on the west side of a rainforest stream. When we first encountered the snake, it was feeding on an adult *Colostethus panamansis* (Panama Rocket Frog, formerly known as *C. inguinalis*; Cope 1868. Proc Acad P. 20:96–140). With the frog positioned sideways (perpendicular) in its mouth (Fig. 1), the snake remained immobile for at least 5 min, while we collected photographic records. After this period, the snake abruptly spit out the frog and lunged towards the observers (CL, SML). At 1156 h, on the east side of the stream, we found another juvenile *B. asper* under a large rock ca. 70 m from the first encounter site. Although this snake was not feeding on a frog, it was within 5 m of at least three calling *C. panamansis*, and we counted eight other *C. panamansis* calling along the stream between the two encounter sites.

Colostethus panamansis is a small, stream-associated, diurnal dendrobatid frog with conspicuous calling behavior, small territory size (up to 0.47 m²), and high rate of philopatry (Wells 1980. Behav. Ecol. Sociobiol. 6:199–209; Rosa et al. 2022. Ecosphere 13:e4158). While these characteristics suggest it could make an ideal prey item for *B. asper*, it is also one of two



FIG. 1. Juvenile *Bothrops asper* ingesting an adult *Colostethus panamansis* near El Cope, Panama.

anuran species in Panama that is known to contain tetrodotoxin in its cutaneous mucus (Daly et al. 1994. Toxicon 32:279–285). Tetrodotoxin (TTX) is a powerful neurotoxin known to be highly lethal for predators (Brodie 1968. Copeia 1968:307–313), including in well-documented amphibian-snake interactions that have helped to understand predator-prey co-evolutionary dynamics (e.g., Brodie et al. 2002. Evolution 56:2067–2082; Reimche et al. 2020. J. Anim. Ecol. 89:1645–1657). Though mutations that confer resistance to TTX have been described for some colubrid snakes (Feldman et al. 2012. Proc. Natl. Acad. Sci. USA 106:13415–13420), these mutations have not yet been found in pit vipers to date and are not present in all colubrids that consume TTX-defended prey (Feldman et al. 2016. Heredity 116:84–91). Thus, while *B. asper* may obtain TTX through consumption of *C. panamansis*, their mechanisms of TTX resistance are still unknown.

While this is the first record of *B. asper* attempting to feed on *C. panamansis*, it may not be an unusual prey item. Encountering two snakes in a short period of time (ca. 26 min) suggests a relatively high abundance of juvenile *B. asper* along this stream, where *C. panamansis* is one of the most abundant frogs despite having suffered population declines due to chytridiomycosis (Lips et al. 2006. Proc. Natl. Acad. Sci. USA 103:3165–3170). Fortunately, populations are recovering (Voyles et al. 2018. Science 359:1517–1519). Snake populations of several species, including *B. asper* had also declined along with their amphibian prey (Zipkin et al. 2020. Science 367:814–816). The fact that we found both prey and predator in relatively high abundance may also indicate signs of recovery.

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CAROLINA LAMBERTINI, Department of Biology, University of Nevada, Reno, Reno, Nevada 89557, USA (e-mail: lambertini.carol@gmail.com); **SAMUEL M. LAPP**, Department of Biological Sciences, University of Pittsburgh, Pittsburgh 15260, USA (e-mail: sam.lapp@pitt.edu) and **JAMIE L. VOYLES**, Department of Biology, University of Nevada, Reno, Reno, Nevada 89557, USA (e-mail: jamie.voyles@gmail.com).