

First in-situ record of courtship and mating in Neuwied's Lancehead, *Bothrops neuwiedi* Wagler, 1824

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The genus *Bothrops* (Viperidae) is composed of morphologically and ecologically diverse venomous snakes that occupy a wide variety of habitats and exhibit predominantly nocturnal and terrestrial habits (Campbell and Lamar, 2004; Carrasco et al., 2012). The reproductive cycle of *Bothrops* spp. is generally seasonal, and reproductive events such as spermatogenesis, vitellogenesis, and fertilisation are often dissociated from the mating period (Aldridge and Duvall, 2002; Almeida-Santos and Salomão, 2002). Activity peaks occur in summer and autumn (January to May), and the mating season occurs in autumn (March to June), coinciding with the onset of vitellogenesis, which lasts until early spring (October). Sperm storage occurs in both sexes during autumn and winter (May to September), while ovulation and fertilisation occur in spring (September to December). Parturition occurs in summer (January to March), coinciding with the period of greater resource availability (Almeida-Santos and Salomão, 2002; Silva et al., 2020). Despite the availability of general information about the reproductive cycle in *Bothrops*, which is usually based on specimens preserved in collections (e.g., Monteiro et al., 2006; Barros et al., 2014a, 2014b; Almeida-Santos et al., 2017; Bisneto and Kaefer, 2019), in-situ observations are rare (Amorim et al., 2019; Menezes et al., 2019). Here we describe the first in-situ record of courtship and mating behaviour of *B. neuwiedi*.

Bothrops neuwiedi Wagler, 1824 is endemic to Brazil, with records in central-western (Goiás and Distrito

Federal), northeastern (Bahia), southeastern (Minas Gerais, Rio de Janeiro, and São Paulo), and southern states (Paraná, Santa Catarina, and Rio Grande do Sul) (Silva and Rodrigues, 2008; Costa et al., 2022). This species occurs mainly in high-elevation regions associated with open fields, rocky fields, savannahs, and altered habitats (Nogueira et al., 2019). At 11:30 h on 27 April 2021, ACRN recorded an interaction between two *B. neuwiedi* individuals on a trail in Pico do Itambé State Park (18.4166°S, 43.3333°W), municipality of Santo Antônio do Itambé, Minas Gerais, southeastern Brazil. Three behavioural phases were observed: tactile chase, tactile alignment, and intromission/coitus. The male individual (smaller in body size) positioned himself by aligning his body over the female (larger in body size with anomalous colour pattern) (Fig. 1). The tactile chase behaviour involved undulation, caudocephalic waves, and forward movements that were performed by the male on the female's back while tongue flicking intensely. About one minute later, the male shook the base of his tail and retracted his body. After approximately five minutes, the male again moved his body over the female and repeated the tail shaking, attempting to retract the female's body (Fig. 1). The male exhibited tactile alignment, in which he attempted to pair the cloacae for hemipenis insertion and curled his tail around the female's tail. Next, the male performed a tail search for a copulatory attempt. The female then performed a cloacal gaping, which allowed a successful hemipenis intromission (Fig. 1). Mating behaviour was observed for 40 min. The end of copulation was not recorded, however.

The courtship and mating behaviour of male *B. neuwiedi* described here resembles that of other species (Gillingham, 1987; Silva et al., 2013). The fact that the female kept her body stretched out and exhibited cloacal gaping indicates that she was receptive to male courtship, and thus there was no need for coercive mating (Shine et al., 2003). The autumnal mating (April) reported here agrees with previous observations of captive conspecifics (Silva et al., 2013) as well as

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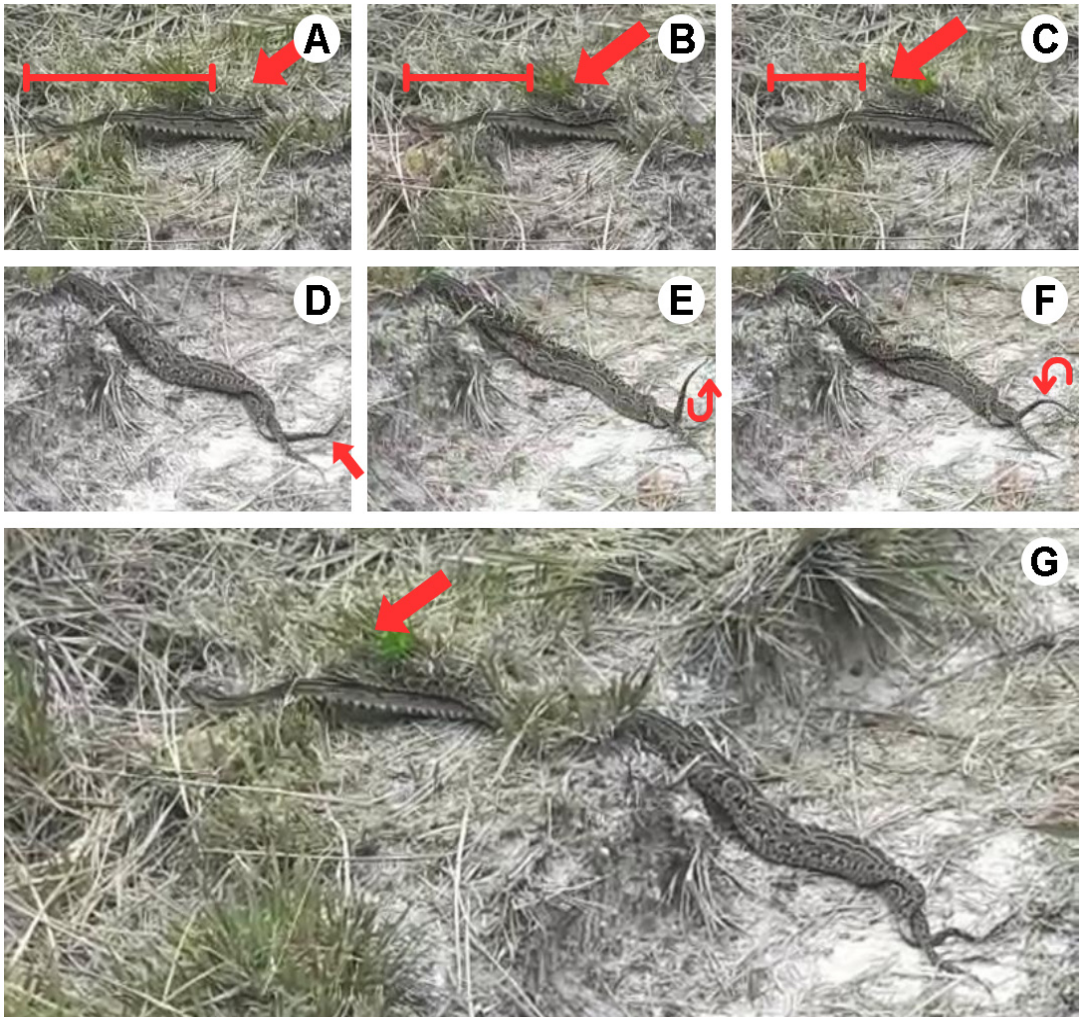


Figure 1. Courtship of free-ranging *Bothrops neuwiedi*. Upper row (A-C): the male (indicated by arrows) displays caudocephalic waves and forward movements on the female's back with intense tongue flicking (horizontal bar shows the distance between male's and female's heads). Middle row (D-F): the male initiates tail search copulatory attempt (indicated by arrows) to introduce the hemipenis. Lower row (G): the male successfully introduces the hemipenis in the female's cloaca. Photos by Adão C. Rodrigues-Neto. Disclaimer: The images exhibit lower resolution because of recording behavioural events on video, followed by transmission to the authors through mobile phones. The inherent data compression during this process has led to a reduction in image quality.

captive and free-ranging congeners (Alves et al., 1998; Almeida-Santos and Salomão, 2002). Our observation also corroborates suggestions that the reproductive behaviour of the species occurs in autumn (Silva et al., 2013).

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