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SHORT COMMUNICATION

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# First record of mating between a pair of putative *Crotalus basiliscus* and *Crotalus nigrescens* suggests the potential for hybridisation areas in the Sierra Madre Occidental, Mexico

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Hybridisation in rattlesnakes has been documented extensively (Klauber, 1972; Campbell & Lamar, 1989; Zancolli et al., 2016; Maag et al., 2023), and recent genomic evidence suggests that rattlesnake populations previously classified as subspecies are distinct species that frequently hybridise in areas where their ranges overlap (Myers et al., 2024). The rattlesnake *Crotalus basiliscus* and those formerly considered subspecies of *Crotalus molossus*, such as *Crotalus nigrescens*, have a wide distribution in North America (Fig. 1; Muñoz-Mora et al., 2022). *Crotalus basiliscus* is found along the west coast of Mexico from southern Sonora to Michoacán (McCranie, 1981; Goldberg et al., 2005), while *C. nigrescens* exhibits an extensive distribution across central and northern Mexico, ranging from the Sierra Madre Occidental to the northern side of the Trans-Mexican Volcanic Belt (Price, 1980; Muñoz-Mora et al., 2022).

The reproductive cycles of *C. basiliscus* and *C. nigrescens* bear a resemblance to that of other rattlesnakes of the molossus group with reproductive activity from late spring to early autumn (Goldberg, 1999; Goldberg et al., 2005). Both species are capable of sperm storage (both males and females) until the following season. Typically, female *C. basiliscus* demonstrate annual reproduce cycles (Goldberg et al., 2005), whereas *C. molossus* females exhibit biennial cycles, producing litters every other year (Goldberg, 1999).

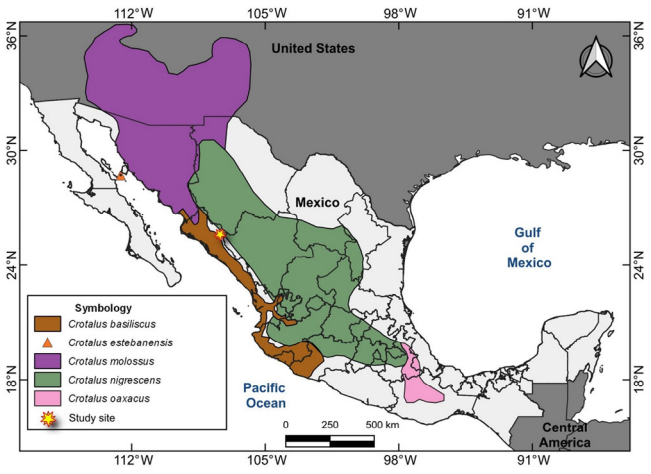


**Figure 1**. Distribution of *Crotalus basiliscus* and several species of the molossus group; *Crotalus ornatus* and *Crotalus totonacus* not included (Myers et al., 2024). The map is based on information in Price (1980), McCranie (1981), Lara-Galván et al. (2020), Muñoz-Mora et al. (2022), and historical records of the species (GBIF, 2024).


**Figure 2**. **A.** *Crotalus basiliscus*, **B.** The tails of both *Crotalus basiliscus* and *Crotalus nigrescens*, red arrow indicating a bulge in the female cloaca, **C.** & **D.** *Crotalus nigrescens*

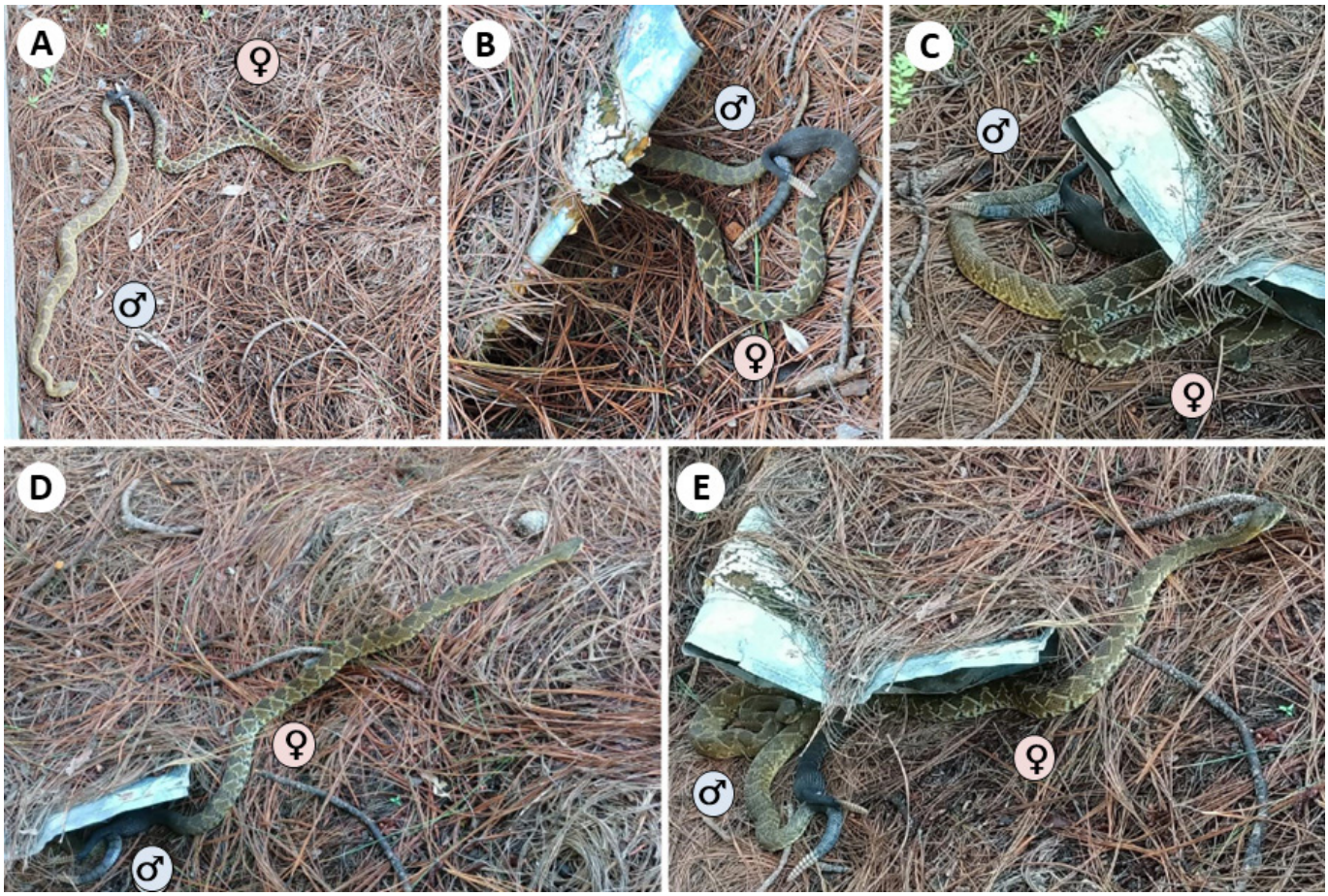


**Figure 3**. **A.-E.** Observation of mating between *Crotalus basiliscus* and *Crotalus nigrescens*

Although the geographic distributions of *C. basiliscus* and *C. molossus* group species are essentially mutually exclusive (Fig. 1), there is overlap and a high potential to overlap in some areas of their ranges (Price, 1980; McCranie, 1981; Muñoz-Mora et al., 2022; Lara-Galván et al., 2020). For example, Klauber (1952) noted cases of *C. molossus* from southern Sonora exhibiting traits intermediate with *C. basiliscus*, including head and tail length, hemipenial spine count, subcaudal count and colouration patterns. He also reported a specimen of *C. basiliscus* from Jalisco that resembled *C. nigrescens* owing to a reduced number of subcaudal scales and a black tail. Subsequently, Hardy & McDiarmid (1969) suggested that *C. basiliscus* and *C. molossus* are likely sympatric in northern Sinaloa based on morphological evidence. See Figure 1 for plenty of contact points and overlap.

Reports documenting instances of natural mating between different species are significant due to their implications for understanding speciation mechanisms and the development of reproductive barriers (Coyne & Orr, 2004). Studies on courtship in rattlesnakes include reports on both captive individuals (Perkins, 1943; Klauber, 1972; Armstrong & Murphy, 1979; van Der Heiden, 2019), and observations in the wild (Bryson & Lazcano, 2002; Prival et al., 2002; Clark et al., 2014; Almeida-Santos et al., 2021; Senter, 2022).

Here, we present an observation of mating between *C. basiliscus* and a putative individual of *C. nigrescens* in the north-east of Sinaloa, Mexico. Our record represents the first documented case of mating in these two species, and among the few cases where potential hybridisation under wild conditions has been documented photographically in rattlesnakes. The photographs have been catalogued in the Colección de Imágenes Herpetológicas del Museo de Zoología 'Alfonso L. Herrera' of the Universidad Nacional Autónoma de México (MZFC-HE-IMG225-229).

On 30 September 2023, at 09:50 h, during a visit to the Sierra Madre Occidental of Sinaloa, Mexico, we were alerted by personnel from the Centro de Estudios "Justo Sierra" (CEJUS) that a pair of mating rattlesnakes had been observed in the Surutato Ecological Preservation Zone (25° 49' 45.91" N; 107° 33' 54.08" W; WGS84; altitude 1,528 m a.s.l.) in the municipality of Badiraguato, Sinaloa, Mexico (Fig. 1). This observation took place on a sunny, clear morning, with a temperature of 24 °C and relative humidity of 68%, recorded immediately after encountering the rattlesnakes. The snakes were concealed behind a hut amidst pine needles. We observed them for approximately 3 h from a distance of 2.5 m without disturbing them; consequently there was no opportunity to measure them. The male had the typical appearance of *C. basiliscus* and the female resembled *C. nigrescens* (Fig. 2).

No courtship behaviours were observed, as the snakes were already copulating. The female had a noticeable bulge near the cloaca (Fig. 2B), undoubtedly the male's engorged hemipenis. No bleeding was noted (Fig. 2B). A sequence of photographs was taken of the mating pair (Fig. 3 A–E). During copulation, we observed intermittent pulsing of the male's tail without a specific movement pattern, while the female

continuously followed the male with their cloacae connected (Fig. 3C & D). The male did not resist the female's movements (Fig. 3E). We left the site at 13:00 h as the female appeared restless and unable to separate from the male. Upon returning 3.5 h later (16:30 h), the snakes had departed. Local students from CEJUS reported that the rattlesnakes had likely been copulating for approximately 20 hours, as they had observed the snakes joined and intertwined on 29 September at 17:47 h, though this could not be confirmed directly. Armstrong & Murphy (1979) reported durations of 9.2 and 1.45 h for pairs of *C. molossus*, and up to 10 hours for captive *Crotalus willardi*. Klauber (1972) reported durations of 22.45 h in *Crotalus ruber* and 15 to 24 h in *C. willardi*. Although there are few records of copulation duration in wild rattlesnakes, durations of 24 to 28 h have been reported (Clark et al., 2014).

Future work should include genomic analysis of individuals in the various regions of contact and their putative hybrids.

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