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Description of the first visual record of copulation in *Liolaemus pseudolemniscatus* Lamborot and Ortiz 1990 (Squamata, Liolaemidae)

Descripción del primer registro visual de cópula en *Liolaemus pseudolemniscatus* Lamborot and Ortiz 1990 (Squamata, Liolaemidae)

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Despite numerous studies on the biology and ecology of the *Liolaemus* genus, records of reproductive behavior of courtship and mating in natural conditions remain scarce (e.g., González-Candia 2019). The identification of these reproductive dynamics is, in some cases, inferred through direct observation of bite marks left by males on the neck or flanks of females during mating (Rodríguez-Domínguez & Molina-Borja 1998, Vidal & Labra 2008, Lujan-Ogeda et al. 2023). In the central zone of Chile, there is information on this behavior in *Liolaemus* and other taxa, which can be observed typically between late winter and early spring (August to October) (Vidal & Labra 2008, González-Candia 2019). These records are mainly characterized by dominant male behavior towards the female, involving displays such as pursuit, sustained biting, mounting, and short-duration copulations (see Rodríguez-Domínguez & Molina-Borja 1998, González-Candia 2019, Lujan-Ogeda et al. 2023). As seen in other lizard species, it is possible that the sequence or stages involved in reproductive behavior may not always be completed, or that mating interactions may not always result in copulation (Rodríguez-Domínguez & Molina-Borja 1998).

The false lemniscate lizard, *Liolaemus pseudolemniscatus* Lamborot & Ortiz 1990, is a small reptile endemic to central Chile, ranging from coastal areas to the Andean foothills (25 to 2100 m), between Los Hornos in the Coquimbo Region (29°36.41'S, 71°13.31'W) and Cerro Provincia in Metropolitan Region (33°23'S, 70°27'W) (Chávez-Villavicencio 2022). Its primary habit is terrestrial, although it is also considered saxicolous or with preference to be near shrubby vegetation (Demangel 2016).

On August 2, 2023, several individuals of *Liolaemus pseudolemniscatus* (Gravenhorst, 1838) were found in El Toro ravine, 22 km southeast of the city of Los Andes (Valparaíso Region;

33°0.562'S, 70°28.696'W, 1984 m). The site features an open landscape of rocky outcrops and stones, and a vegetational formation of thorny scrubland and grassland, dominated by herbaceous and low woody shrubs (Fig. 1). The area is located on a north-facing hillside with variable unevenness and a gentle slope. Weather conditions at the time of the sightings were favorable for daytime reptile activity, with clear sky, light to moderate winds, and a high thermal sensation. The specimens were observed cohabiting with other lizards commonly described in sympatry (e.g., *L. fuscus*, *L. nitidus*, and *L. monticola*) (see Lamborot & Ortiz 1990, Troncoso-Palacios 2011).



Figure 1: Habitat of *Liolaemus pseudolemniscatus* in the locality El Toro ravine, Andes mountain range. Photograph by Pablo Lamilla-Maulén. Figura 1: Hábitat de *Liolaemus pseudolemniscatus* en la localidad de quebrada El Toro, Cordillera de los Andes. Fotografía de Pablo Lamilla-Maulén.

At midday (12:59 p.m.), during a pedestrian survey of the area, I photographed the mating behavior between a male and female of *L. pseudolemniscatus*, which were actively moving on a stony soil substrate. It was possible to observe six consecutive behavioral stages, corresponding to some formally described reports in other species of *Liolaemus* and *Phymaturus*, such as *L. tenuis*, *P. maulense*, *P. vociferator*, as well as in species from other lizards families, such as *Callopiastes maculatus* (see Vidal & Labra 2008, Eisenberg & Werning 2012, González-Candia 2019, Pérez-Cid 2019, Gagliardi-Álvarez 2023).

For the individuals observed in this study, the lunge was first recorded, with a rapid approach of the male towards the female and repeated mounting attempts, followed by the immobilization through a bite on the neck and scapular region of the female, who displayed resistance to the male's actions. Subsequently, 19 seconds later, the precopulatory or mounting stage was observed, during which the male climbed onto the female's dorsal side, while pressing on her neck and positioning his anterior and posterior limbs around her body (Fig. 2A). The duration of this stage was less than 20 seconds, after which the male and female simultaneously turned their bodies sideways, corresponding to the copulation stage (juxtaposition of the cloacae). At this point, the male may have introduced one of his hemipenis into the female's cloaca, while holding her dorso-ventrally throughout the process by means of a lateral bite on the neck (Fig. 2B). The copulation lasted less than 10 seconds, after which the female disengaged, leading to genital separation, release of the bite, and the subsequent withdrawal of both individuals to an adjacent refuge under a rock and thorny shrub vegetation. The total duration of the recorded event was less than 5 min, as determined from the time stamps of a series of photographs taken with a Canon PowerShot SX70 HS Digital Camera.



Figure 2: Mating behavior of *Liolaemus pseudolemniscatus*. A) Precopulatory stage (immobilization): posterior view (12:59:19 p.m.). B) Copulation stage (juxtaposition of the cloacae): ventral view (12:59:32 p.m.). Photograph by Pablo Lamilla-Maulén. **Figura 2:** Conducta de apareamiento de *Liolaemus pseudolemniscatus*. A) Etapa precopulatoria (inmovilización): vista posterior (12:59:19 p.m.). B) Etapa copulatoria (yuxtaposición de las cloacas): vista ventral (12:59:32 p.m.). Fotografía de Pablo Lamilla-Maulén.

Although there is considerable information about the ecological aspects of genus *Liolaemus* lizards, the knowledge about their reproductive behavior remains limited. This species exhibits

reproductive behavior that shows similarities with other species of the *Liolaemus* genus, as well as with lizards from other genera from Liolaemidae such as *Phymaturus* and from other families such as teiids, leiosaurids, anguids, and iguanids (e.g., see Rodríguez-Domínguez & Molina-Borja 1998, Eisenberg & Werning 2012, Lujan-Ogeda et al. 2023). For example, the precopulatory biting behavior by the male on the female's neck, which may serve the purposes of immobilization, demonstrating dominance, and facilitating copulation, has been interpreted by some authors as a lizard ancestral pattern with evolutionary roots, because it is a widespread trait across reptiles (Rodríguez-Domínguez & Molina-Borja 1998, González-Candia 2019, Lujan-Ogeda et al. 2023).

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