

TAIL BIFURCATION IN A MESQUITE LIZARD *SCELOPORUS GRAMMICUS* (SQUAMATA: PHRYNOSOMATIDAE) IN A POPULATION FROM TOLUCA, MEXICO

BIFURCACIÓN CAUDAL EN UNA LAGARTIJA DEL MEZQUITE *SCELOPORUS GRAMMICUS* (SQUAMATA: PHRYNOSOMATIDAE) EN UNA POBLACIÓN DE TOLUCA, MÉXICO

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Resumen.– Anomalías en la regeneración de la cola se han documentado en diversas familias de lagartijas; sin embargo, la información sobre lacertilios mexicanos es escasa. Aunque *Sceloporus grammicus* es una de las lagartijas más estudiadas en México, aquí documentamos por primera vez la observación de la cola bifurcada en una hembra grávida; además, se incluyen datos sobre la frecuencia de ocurrencia de autotomía caudal en hembras y machos.

Palabras clave.– Anomalía, autotomía caudal, lagartija, regeneración de cola.

Abstract.– Anomalies in tail regeneration have been documented for various families of lizards; however, information for Mexican lizards is scarce. Although *Sceloporus grammicus* is one of the most studied lizards in Mexico, here we document for the first time the observation of a gravid female with tail bifurcation. In addition, we include data on the frequency of occurrence of caudal autotomy in females and males.

Keywords.– Abnormality, caudal autotomy, lizard, tail regeneration.

Caudal autotomy is the capability to drop all or a portion of the tail, is found in many lizard species. This ability is mainly used as a defensive behavior when threatened by a predator (Barr et al., 2021). This phenomenon occurs due to the presence of fracture planes in different regions of the caudal vertebrae associated with tissues where the tail break occurs. Subsequently, the tail regeneration process begins. However, the regenerated tail is not an exact copy of the original, as it involves the replacement of bone by a cartilaginous tube (Lozito & Tuan, 2015). During the regeneration process, anomalies can arise as a result of an injury or an incomplete autotomy event where the original tail remains partially attached (Barr et al., 2021). As a consequence, abnormalities can cause the growth of more than one tail and produce a furcation (Barr et al., 2020).

Tail abnormalities, including bifurcation and trifurcation, have been documented in several families of lizards (see Table S1 in Barr et al., 2020); nevertheless, records in Mexican lizards, are scarce [e.g., *Urosaurus bicarinatus* (Mata-Silva et al., 2013); *Plestiodon copei* (Suárez et al., 2020), and recently in *Aspidoscelis costatus costatus* (De la Rosa-Silva et al., 2023), *Aspidoscelis guttatus* and *Phyllodactylus magnus* (Nieto-Toscano & Cruz-Ramírez 2023)]. In general, information and descriptions about tail status, tail bifurcation, and type of fracture plane are lacking and limited mainly for members of the family Phrynosomatidae [e.g., *Cophosaurus texanus*, *Holbrookia elegans*, *Sceloporus occidentalis*, *Sceloporus uniformis*, *Sceloporus variabilis*, *Urosaurus ornatus*, and *Uta stansburiana* (Barr et al., 2020)].

The viviparous lizard *Sceloporus grammicus*, is widely distributed in Mexico, from sea level up to elevations above 4,000 m. These lizards exploit different microenvironments such as rocks, trees, scrub, walls and human settlements (Leyte-Manrique et al., 2017). This lizard is perhaps the most well-researched in Mexico, with studies that include ecology (Lemos-Espinal & Ballinger, 1995), evolution (Bastiaans et al., 2013), physiology (Rivera-Rea et al., 2023), and genetics (Marshall et al., 2006). Here, we report the first case of tail bifurcation in a population of *S. grammicus* and data on the frequency of occurrence of tail autotomy.

On 29th February 2024, we collected lizards at Universidad Autónoma del Estado de México, located in “El Cerrillo, Piedras Blancas”, municipality of Toluca, State of Mexico, Mexico (19.41181° N, 99.70067° W, datum WGS84, 2,605 m a.s.l.). The locality is a suburban area surrounded by fragmented and secondary vegetation, with introduced cattle pasture.

In this study area, we manually captured a pregnant female and measured with a digital caliper (precision 0.01 mm) the snout-vent length (SVL) = 54 mm, and body mass = 5.5 g, obtained with a Pesola® (precision 0.5 g), the female had the tail dorsoventrally bifurcated forming an acute angle; the

bifurcation point was posteriorly located 33 mm from the vent on the original portion of the tail. The length of the dorsal regenerated branch was slightly shorter (9 mm) than ventral side (14 mm); the ventral branch showed a curly shape at the end point of the tail (Fig. 1). The scales from the bifurcated point were less keeled than the original tail. Additionally, during sampling, we collected 70 adult lizards [$n = 47$ females (45 pregnant), and $n = 23$ males], the sex ratio was biased to females ($X^2 = 8.22$, $p = 0.004$); of which, 22.8 % ($n = 11$ females and $n = 5$ males) had regenerated tails. All captured lizards were released at the collecting site after sampling. Caudal autotomy was mostly detected in females with a slightly higher percentage of regenerated tails (30.5 %) than males (27.8 %) without difference in frequency of occurrence by sex ($X^2 = 2.25$, $p = 0.13$). This suggests that even though females may lose their tails before the gestation, they are more vulnerable to predation during the pregnancy period, contrary to the recorded by Leyte-Manrique et al. (2007), where males have a higher percentage of regenerated tails than females as they are at more risk during courtship and reproduction, this maybe for the asynchronous gonadal activity and differential use of habitat during the reproductive cycle (Jiménez-Cruz et al., 2005). Although the occurrence of tail bifurcation may be common in a species with wide distribution, to our knowledge, this is the first report of a tail abnormality in *S. grammicus*. Also,



Figure 1. Pregnant female of *Sceloporus grammicus* with tail bifurcation at el “Cerrillo, Piedras Blancas”, Toluca, Estado de México, México. Photo: Oswaldo Hernández-Gallegos..

Figura 1. Hembra grávida de *Sceloporus grammicus* con cola bifurcada en el “Cerrillo Piedras Blancas”, Toluca, Estado de México, México. Foto: Oswaldo Hernández-Gallegos.

this observation suggests incomplete tail autotomy would be caused by a predatory attempt or by an intraspecific encounter.

Our finding is of special interest due to the rarity of detecting these types of phenomena in the natural environment and since different species of lizards use their tails for various purposes, the tail is important for locomotion, balance, foraging, defense, decoy, mating, courtship, fat storage, survival and subjection in lizard species with prehensile tail (Barr et al., 2021; Maglangit et al., 2021). Additionally, tail malformation may hinder locomotion performance and fitness, which increases predatory encounters that affect their survival (Maglangit et al., 2021). Future studies should try to explain the effect of the tail malformation on the performance, and ecological flexibility.

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