THERYA NOTES 2020, Vol. 1 : 106-109 DOI: 10.12933/therya_notes-20-23 ISSN 2954-3614

Observations of lesions in *Sturnira parvidens* from Central México

Observaciones de lesiones en *Sturnira parvidens* en el centro de México

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Observations on health condition of organisms are useful to understanding the species biology, particularly because aspects as diseases and lesions are little known in phyllostomid bats, despite their high diversity in the Neotropical region. We reported two anomalies found in the northern yellow-shouldered bat (*Sturnira parvidens*) at a northwest locality of the state of Hidalgo, México. Bat sampling was carried out on February 2020 using three mist nets (46.8 m^2 net / night) at a locality of the municipality of Nicolás Flores. The individuals were measured and identified to species level, and conventional somatic measures, in addition sex and reproductive condition were determined. From a sample of 29 individuals of *Sturnira parvidens*, two of them showed physical anomalies; one male had a lesion on the metacarpal bone of the second finger of the right wing, and other male presents alopecic syndrome in their back. Bone fractures apparently are less frequent compared to other wing damages in bats, but it is difficult to establish their causes, and alopecic syndrome may be a rare condition in *S. parvidens*, but more studies to identify the etiologic agents that produce this disease are needed.

Key words: Alopecic syndrome; anomalies; Chiroptera; fracture; lesions; metacarpal; phyllostomid bats.

Las observaciones sobre las condiciones de salud de los organismos son útiles para comprender la biología de las especies, particularmente porque las enfermedades y lesiones son poco conocidas en los murciélagos filostómidos, a pesar de la alta diversidad de este grupo en el neotrópico. Reportamos dos anomalías físicas encontradas en el murciélago norteño de charreteras (*Sturnira parvidens*) en una localidad del noroeste del estado de Hidalgo, México. El muestreo de murciélagos se realizó en febrero de 2020 utilizando tres redes de niebla (46.8 m^2 red / noche) en una localidad del municipio de Nicolás Flores. Los individuos capturados fueron medidos e identificados a nivel de especie y se determinaron las medidas somáticas convencionales, además del sexo y su condición reproductiva. De una muestra de 29 individuos capturados de *Sturnira parvidens*, dos de ellos mostraron anomalías físicas; un macho presentó una lesión en el hueso metacarpiano del segundo dedo del ala derecha y otro macho exhibió síndrome alopécico en la espalda. En murciélagos, las fracturas óseas son menos comunes en comparación con otros tipos de daños en sus alas, pero es difícil establecer las causas de estas lesiones. El síndrome alopécico puede ser una condición rara en *S. parvidens*, pero aún es necesario identificar los agentes etiológicos que producen esta enfermedad.

Palabras clave: Anomalías; Chiroptera; fractura; lesiones; metacarpo; murciélagos filostómidos; síndrome alopécico.

Bats are a highly diverse group that occurs in all continents except Antarctica (Fenton and Simmons 2014). They play vital functions in the ecosystems, but unfortunately face many threats (*e.g.*, habitat loss, bushmeat hunting, and climate change) that increase the risk of local or global extinctions (Frick *et al.* 2020). Globally, the most frequent mortality events in bats are viral infections and bacterial diseases, as well as lesions due to accidents (O'Shea *et al.* 2016). However, information about diseases and lesions in phyllostomid bats has been poorly documented, and the available reports include only few species without detailed statistical summaries (Cichocki *et al.* 2019). In this context, possibly one of the least known aspects of Chiroptera are the causes and types of damage in their wings and other flight–enabling body parts.

Cichocki *et al.* (2019) classified the damage to southern and western Poland bat wings into five groups: tears in the wing, holes in wings, losses in the wing and tail membrane, loss of a finger membrane, and bone fractures. Apparently, some ecological determinants such as types of habitats and foraging mode determine the frequency of wing damages among bat species (Cichocki *et al.* 2019). Cat predation is responsible for traumatic injuries and wing lacerations in bat species roosting in buildings (Mühldorfer *et al.* 2011). Other injuries in bat wings are caused by fungal diseases, such as white nose syndrome, due to necrosis in the wing membrane (Fuller *et al.* 2011) and for individuals trapped in confined spaces (Mühldorfer *et al.* 2011). Additionally, it has been documented traumas, including bones fractured, elbow laceration, and compound wing fracture, sustained by migratory bats due to impact against wind turbines (Klug and Baerwald 2010). Some malformations in bat wings are congenital anomalies that include polydactyly and underdeveloped in radius and ulna, but apparently these types of anomalies are rarer (Kunz and Chase 1983).

Some isolated cases of wing damage due to different types of affectations have been reported in the following bat taxa: *Eptesicus fuscus* (Kunz and Chase 1983), *Barbastella barbastellus*, *Myotis daubentonii*, *M. myotis*, *M. nattereri*, *Plecotus auritus, Rhinolophus hipposideros* (Cichocki *et al.* 2019), *M. albescens*, *M. nigricans* (Voigt 2013), *M. lucifugus* (Fuller *et al.* 201i), *Lasiurus cinereus, Lasionycteris noctivagans* (Klug and Baerwald 2010), *Pipistrellus pipistrellus* (Garcês *et al.* 2017), *M. mystacinus*, *Vespertilio murinus,* and *Nyctalus noctula* (Mühldorfer *et al.* 2011).

On the other hand, hair loss or alopecic syndrome is a condition multifactorial in mammals that has been associated with allergens, ectoparasites, fungal dermatitis, bacterial, nutritional deficiencies or toxicities, hormonal imbalances and stress (Noxon 1995; Novak and Meyer 2009; Tang *et al.* 2012; Novak *et al.* 2014; Pugliares-Bonner *et al.* 2018). In bats, this condition it has been reported after disturbance events (Pedersen *et al.* 2012), poor condition habitat, anthropogenic activities, and physiologic stress (Tang *et al.* 2012).

The northern yellow-shouldered bat (*Sturnira parvidens*) is a medium-sized species that inhabits in a wide range of habitats (Gannon *et al.* 1989). It is found in both humid and semi-arid forests and usually it selects moist parts of forests and open areas (Handley 1976). It is widely distributed, occurring probably from Sonora in the Mexican Pacific Slope, and Tamaulipas in the Mexican Gulf Slope, including the Yucatán Peninsula in México, southward to north Costa Rica (Sánchez-Hernández *et al.* 2016; Solari 2019; Hernández-Canchola and León-Paniagua 2020). This bat species has a predominantly frugivorous-omnivorous diet (Sánchez-Hernández *et al.* 2016; Solari 2019), and consumes flowers and fruits from Piperaceae, Solanaceae, Melastomataceae, and Moraceae (Sánchez-Hernández *et al.* 2016).

In this work, we report two anomalies found in two individuals of *S. parvidens*, an individual with a lesion in one metacarpal bone, and other ones with alopecic syndrome on the back at a northwest locality of the state of Hidalgo, México, and we discuss the possible causes.

Bat sampling was carried out on 15 and 16 February 2020 at Pijay locality (20.7749 N, -99.1769 W) from the municipality of Nicolás Flores in the state of Hidalgo, México (Figure 1). This municipality is part of the north of the Valle del Mezquital and is located in the Sierra Madre Oriental mountain range (Sánchez-González *et al.* 2008). The main climate is sub-warm temperate, with an annual average temperature of 16 °C and an annual rainfall of 470 mm; the rainy period is from March to September (Sánchez-González *et al.* 2008). The main types of vegetation present in the municipality are thorny scrub at lowest altitude, and juniper forest, oak forest, and pine-oak forest at highest altitude. The habitat at Pijay locality corresponds to a gallery forest with the presence of thorny scrub on the nearby slopes.

We used three mist nets (two mist nets of 12 m long and one of 6 m long by 2.6 m high; 46.8 m^2 net / night) that were set at ground level and were opened at dusk for five consecutive hours. Mist nets were checked approximately every 20 min and bats were temporarily stored in cloth bags for data processing. All bats were measured and identified to species level using dichotomous keys (Medellín *et al.* 2008; Álvarez-Castañeda *et al.* 2017). *Sturnira parvidens* can be distinguished from the highland yellow-shouldered bat (*S. hondurensis*) by their lower incisor bi-lobbed and the forearm length between 41 to 45 mm (Álvarez-Castañeda *et al.* 2017). In order to avoid recapturing the same individuals during our sampling, the bats were marked in their wing membrane assigning them a consecutive number using a non-toxic permanent marker. Conventional somatic measures were taken for all captured individuals: ear length, forearm length (FAL), metacarpal length of third digit, foot length (± 1 mm precision), and body mass (BM; ± 1 gr precision). The sex and reproductive condition also were determined.

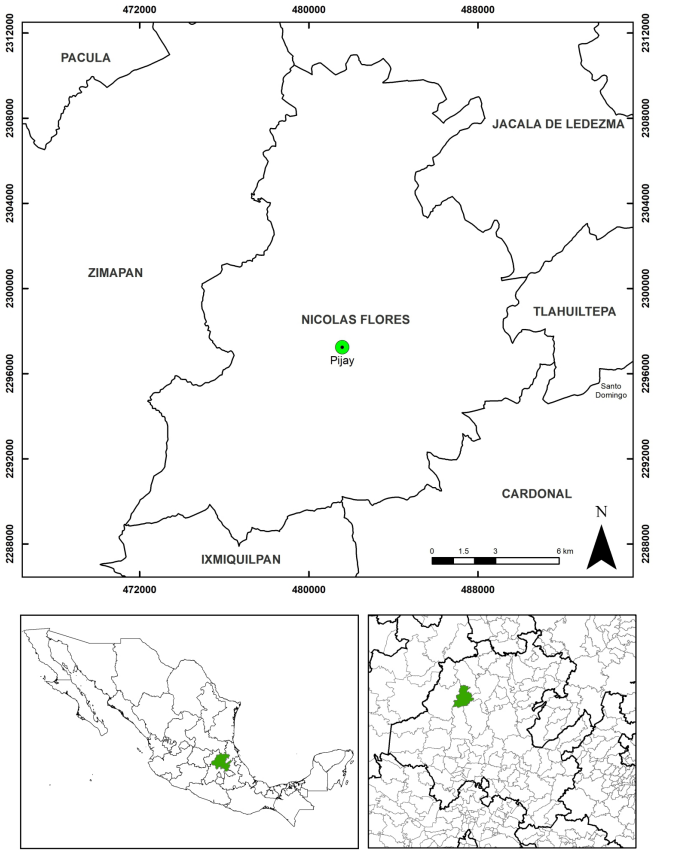

Figure 1. Location of the study area at Pijay from the municipality of Nicolás Flores in the state of Hidalgo, México.

We captured 30 bats from two species belonging to family Phyllostomidae, the northern yellow-shouldered bat, *Sturnira parvidens* (*n* = 29), and the Aztec fruit-eating bat, *Dermanura azteca* (*n* = 1; active male). All individuals of *S. parvidens* were adults. From all males (*n* = 24), three had scrotum testicles. The rest of individuals, including the females (*n* = 5), were inactive. Two individuals showed physical anomalies; the first one was an adult male with inguinal testicles (FAL = 45 mm, BM = 21 gr) that was caught on 15 February 2020. This male had a lesion on the metacarpal bone of the second finger of the right wing (Figure 2), which visually gives the

appearance that the bone fractured did not heal properly. The second individual was caught on 16 February 2020, it was an adult male with inguinal testicles (FAL = 45 mm, BM = 16 gr) with alopecic syndrome in their back (Figure 2). The affected area by hair loss in back covered 18 x 30 mm.

Bats have the ability to fly actively and possibly due to their maneuverability, high vagility, flight speed, foraging habits, and interaction with predator, the damage to wings is not rare. Wing injures in bats includes a wide variety of damages, both in wing membranes and metacarpal and phalanges bones. It is difficult to determine the real cause of the metacarpal bone injury in the northern yellow-shouldered bat. This type of lesions seems to be result from predator attacks, like cats (Mühldorfer *et al.* 2011), aggressive behavior of other bats, or mechanical damage due to consequence of some bumps against vegetation (Cichocki *et al.* 2019). *Sturnira parvidens* can be classified as a species that forages in highly cluttered spaces and collect fruits close to vegetation (Kalko 1997). In this scenario, it is possible that certain physical obstructions created by trunks, branches, leaves or other elements in the habitats, can affect the performance of the flight of bats and on certain occasions some parts of their wings can be injured. However, because there is not enough information on this topic, to test this preliminary hypothesis more empirical studies to determine the probability of injury occurrence and its possible association with structural characteristics of habitats are needed. On the other hand, bone fractures in bat wings are less frequent compared to other wing damages, such as: tear in wings, losses of finger membrane, or holes in wings (Cichocki *et al.* 2019). According to our observations in the field, apparently this injury does not affect the mobility of this individual, but we do not know if other aspects of their individual fitness may be affected or not, so the future implementation of comparative studies between healthy individuals and with wing lesions could yield answers.

Regarding alopecic syndrome, in bats this condition can arise due to various causes. For example, bats on Montserrat island from the British Crown Colony, this syndrome has been reported due to a zinc deficiency and ingestion of plant toxins (Pedersen *et al.* 2009). Other factors include physiological stress, high ectoparasite loads, or possible mineral deficiencies associated with the ingestion of ash as a consequence of severe alterations in the environment (Pedersen *et al.* 2012).

In southeastern México, alopecic syndrome has been documented in four species of frugivorous bats, including to *S. parvidens* (Bello-Gutiérrez *et al.* 2010). However, the highest prevalence of alopecic syndrome was found in *A. lituratus* (5.6 %), followed by the Jamaican fruit-eating bat (*A. jamaicensis*; 5 %; Bello-Gutiérrez *et al.* 2010). By contrast, for *S. parvidens* and the *S. hondurensis* only one individual (0.4 and 0.6 % of prevalence, respectively) was identified with alopecic syndrome (Bello-Gutiérrez *et al.* 2010). Therefore, we can infer that alopecic syndrome is possibly a rare condition in *S. parvidens*. However, more detailed studies to identify the etiologic agents that produce the alopecic syndrome in the genus *Sturnira* bats are needed.

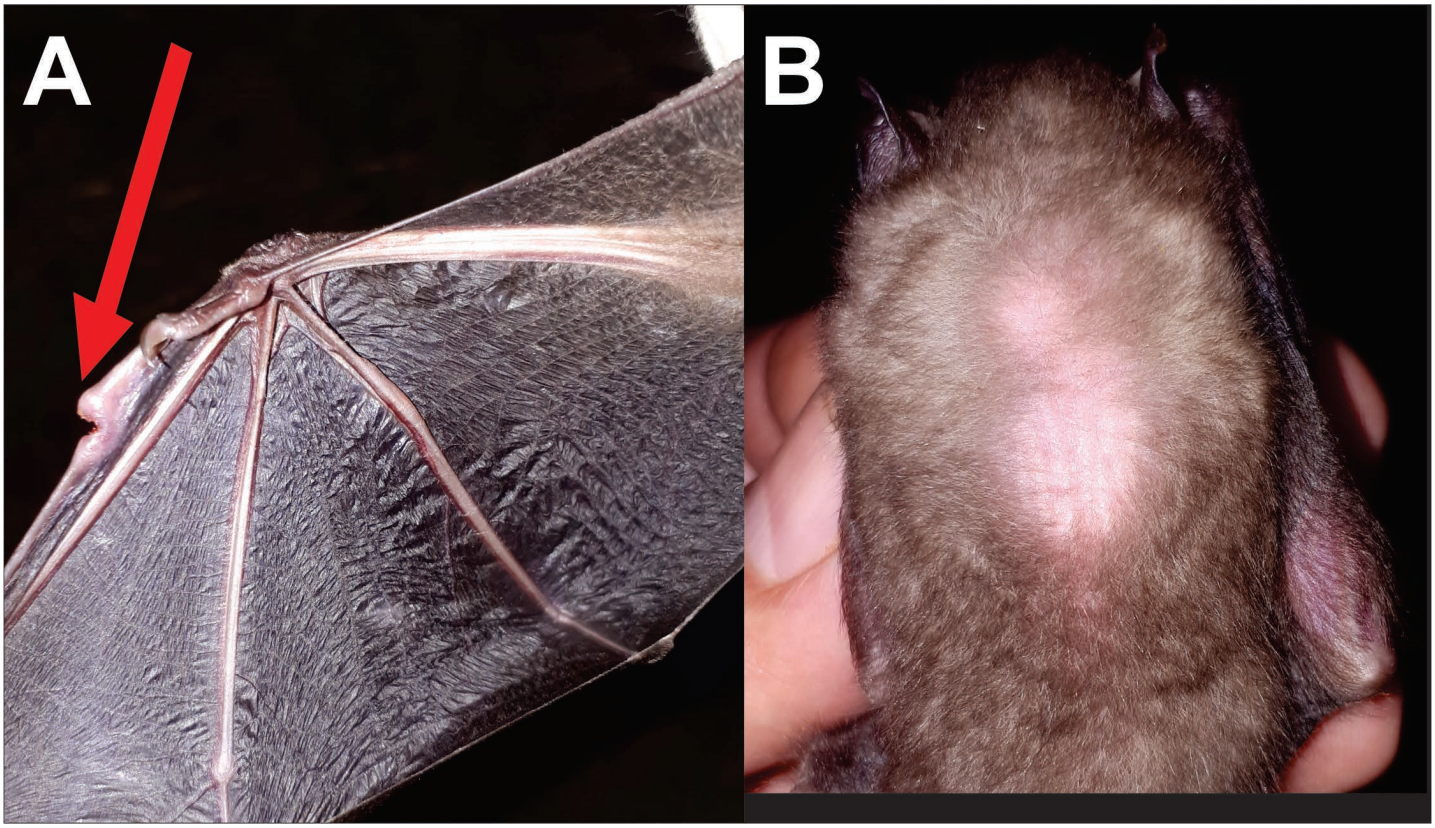

Figure 2. Abnormalities found in the northern yellow-shouldered bat, *Sturnira parvidens* at a northwest locality of the state of Hidalgo, México. A) An adult male with a lesion on the metacarpal bone; the injury is indicated by a red arrow. B) An adult male with alopecic syndrome in their back.

Acknowledgements

We thank R. Jiménez-González for his help in fieldwork and to two anonymous reviewers for their valuable recommendations on this manuscript.

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Associated editor: Beatriz Bolívar-Cimé
Submitted: September 20, 2020; Reviewed: November 23, 2020.
Accepted: November 25, 2020; Published on line: December 8, 2020.