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Rediscovery of the Tamaulipas white-sided jackrabbit (*Lepus altamirae*) after a century from its description

Redescubrimiento de la liebre de flancos blancos de Tamaulipas (*Lepus altamirae*) después de un siglo de su descripción

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The Tamaulipas white-sided jackrabbit, *Lepus altamirae*, was originally described as a subspecies of *Lepus merriami* more than a century ago. Several decades later, it was reclassified as a subspecies of the black-tailed jackrabbit, *L. californicus altamirae*. Despite its ecological, social and economic importance of the jackrabbits, there is a gap in the knowledge of many species, such as *L. altamirae*, since historically few individuals have been sighted, collected and studied. On October 13, 2016 and September 22, 2021, 2 lagomorphs with straw-grayish fur as well as elongated limbs and ears was photographed *in situ* during the surveillance of wildlife in the lowlands of the Huasteca Potosina region, northeastern San Luis Potosí. Due to its coloration, morphological characteristics, and distribution, they were identified as *L. altamirae*. These are the first documented records of the species in the lowlands of the Huasteca Potosina, and the first records after a century of the species description. The closest known records are located *ca*. 98 km east in the state of Tamaulipas. The presence of the Tamaulipas white-sided jackrabbit in the region could be related to land use change. Systematic monitoring is necessary to improve knowledge about the distribution of this and other mammals in the lowlands of the Huasteca Potosina.

Key words: Coastal plain; Gulf of México; hare; lagomorph; Leporidae; San Luis Potosí.

La liebre de flancos blancos de Tamaulipas, *Lepus altamirae*, fue originalmente descrita como una subespecie de *Lepus merriami* hace más de un siglo. Varias décadas después fue reclasificada como una subespecie de la liebre de cola negra, *L. californicus altamirae*. A pesar de la importancia ecológica, social y económica de las liebres, existe un vacío en el conocimiento de muchas especies, tal es el caso de *L. altamirae*, ya que históricamente se han avistado, colectado y estudiado pocos individuos. El 13 de octubre de 2016 y el 22 de septiembre de 2021, 2 lagomorfos con pelaje pajizo-grisáceo, así como extremidades y orejas alargadas fueron fotografiados *in situ* durante el monitoreo de fauna silvestre en la región de la Huasteca Potosina, en el noreste de San Luis Potosí. Por su coloración, características morfológicas y distribución, se identificaron como *L. altamirae*. Estos son los primeros registros documentados de la especie en las tierras bajas de la Huasteca Potosina, así como los primeros registros después de un siglo de la descripción de la especie. Los registros conocidos más cercanos se encuentran *ca*. 98 km al este en el estado de Tamaulipas. La presencia de la liebre de flancos blancos de Tamaulipas en la región podría estar relacionada con el cambio de uso del suelo. Es necesario un monitoreo sistemático para mejorar el conocimiento sobre la distribución de éste y otros mamíferos en las tierras bajas de la Huasteca Potosina.

Palabras clave: Golfo de México; lagomorfo; Leporidae; liebre; planicie costera; San Luis Potosí.

México is one of the countries with the greatest diversity of lagomorphs (Fernández *et al.* 2015); totaling 13 species, 9 of which are rabbits (*Romerolagus* sp. and *Sylvilagus* spp.) and 4 are jackrabbits (*Lepus* spp.; Hoffmann and Smith 2005; Álvarez-Castañeda and Lorenzo 2016; Álvarez-Castañeda and Lorenzo 2017; Vargas *et al.* 2019). Lagomorphs play a key role in several ecological processes (Fernández *et al.* 2015; Brown *et al.* 2018a). They constitute the main prey for some predators (Moreno *et al.* 2004; Laundré *et al.* 2009; Brown *et al.* 2018a), regulate the diversity and structure of plant populations (Hernández *et al.* 2011), and are also an important game species (Leopold 2000; Moreno *et al.* 2004). In general, lagomorphs are conspicuous animals, and their populations are often abundant (Leopold 2000; Fernández *et al.* 2015; Brown *et al.* 2018a). However, their distribution records are scarce in some regions, as is information of their population status (Lorenzo and Jiménez 2013; Vargas *et al.* 2019; Schlater *et al.* 2021).

The Tamaulipas white-sided jackrabbit (*Lepus altamirae*) was originally described as a subspecies of *Lepus merriami* (Nelson 1904). This description was based on the fieldwork of E. W. Wilson and E. A. Goldman, who in 1898

collected 6 jackrabbits in the coastal plain of the Gulf of México, approximately 16 km north of Altamira, in southern Tamaulipas (Nelson 1904, 1909). After that, Nelson (1909) assigned *L. altamirae* to the white-sided group of jackrabbits. Several decades later, it was reclassified as a subspecies of the black-tailed jackrabbit (*Lepus californicus altamirae*; Hall 1951).

Nelson (1904) stated that this jackrabbit has "top of the head grizzled grayish buffy"; dorsal coloration "dull creamy buffy grizzled" and sides of body "slightly paler buffy grizzled with grayish". It has thighs and sides of rump "pale iron gray" and the top of fore feet and legs "dingy buffy". The Tamaulipas white-sided jackrabbit has a bicolored tail; the top of the tail has a black narrow line extending from the middle of rump to the tip of the tail and the underside is grayish white. It also has black nape patch extending back from the base of each ear, separated into two parallel black stripes by a well-defined median yellowish band. The front half of ears are dark buff with a posterior half white and no trace of black at tip (Nelson 1904, 1909). Ranges of average measurements (in mm) of the Tamaulipas white-sided jackrabbit are: total length, 587–605; length of tail vertebrae, 72–96; length of hind foot, 136–137; length of dried ear from notch, 110–112 (Nelson 1904, 1909).

According to Nelson (1909), the geographic distribution of the Tamaulipas white-sided jackrabbit only encompasses the coastal plains of southern Tamaulipas, with the extreme north Veracruz as the limit. This lagomorph inhabits environments between the sea level to an elevation of 150 m, within the "Arid Tropical" zonal range (Nelson 1904 Nelson 1904, 1909). Historically, the records of lagomorphs in the region are scarce. There are, however, few records of the black-tailed jackrabbit (*Lepus californicus*), a species with some shared physical characteristics, in the coastal plain of the Gulf of México (Hall 1951; Álvarez 1963; Vargas *et al.* 2019). Moreover, several authors have been dismissed the presence of jackrabbits in the easternmost portion of San Luis Potosí (Dalquest 1953; Leopold 2000; Ceballos *et al.* 2006; Cervantes and Hernández 2014; Cervantes *et al.* 2014; Farías *et al.* 2015a, 2015b; Martínez de la Vega *et al.* 2016; Brown *et al.* 2018b, 2018c; Brown and Smith 2019; Brown *et al.* 2019; Lavariega and Briones-Salas 2019). Consequently, the objective of our present note was to record the presence of *L. altamirae* in the lowlands of the Huasteca Potosina, in northeastern San Luis Potosí, based on photographic evidence.

The coastal plain of the Gulf of México occupies the eastern portion of the state of San Luis Potosí and part of the states of Nuevo León, Tamaulipas, Hidalgo and Veracruz. This physiographic province extends from the northern border of the country in Reynosa, Tamaulipas, to the area of Nautla, Veracruz (INEGI 2002). Within this coastal plain are the lowlands of the Huasteca Potosina, which encompass the municipalities of Tamuín, Ébano and San Vicente Tancuayalab in northeastern San Luis Potosí. This region is a broad plain with gentle slopes (5-15 %) and includes areas with small hills and scattered low mountains (elevation of 15–150 m); the predominant climate corresponds to a warm sub-humid with summer rainfall (Reyes *et al.* 2014). The main vegetation types in the lowlands of the Huasteca Potosina are tropical low thorn forest, tropical low dry deciduous forest and tropical medium semi-deciduous forest (Reyes *et al.* 2014).

We refer to several authors (Nelson 1904, 1909; Álvarez 1963; Hall 1981; Vargas *et al.* 2019) to assess the known distribution of the species. In addition, we searched for records, including direct observations, photographs, skulls, skins, and/or voucher specimens, in the scientific literature (*i. e.* search engines and scientific electronic libraries such as SciELO, Redalyc, and Google Scholar), and in institutional databases: Global Biodiversity Information Facility (https://www.gbif.org/); Division of Mammals Collections of the Smithsonian National Museum of Natural History (https://mczbase.mcz.harvard.edu/SpecimenSearch.cfm); Museum of Comparative Zoology-Harvard University (https://mczbase.mcz.harvard.edu); Sistema Nacional de Información sobre Biodiversidad de México (https://www.snib.mx/); and VertNet (http://vertnet.org/).

On October 13, 2016, at 14:29 hr, we sighted and photographed (Coolpix L120, 14.1 MP, Nikon Inc., Tokyo, Japan) an individual of Tamaulipas white-sided jackrabbit (Figure 1a) during a surveillance of wild felids (A. Silva-Caballero *pers. comm.*) in the 450 ha private ranch Toriles (Desarrollo Ganadero El Peñón S. P. R. de R. L.; Figure 1b), northern Tamuín, San Luis Potosí (22° 19′ 53.26″ N, 98° 53′ 13.89″ W, 88 m; Figure 2). The sighting took place while we were returning to the base camp, we were driving a vehicle through cattle pastures when the Tamaulipas white-sided jackrabbit jumped from the bush to the road approximately 50–60 m away from us. The surrounding vegetation type in the area is cultivated grasslands, since the main activity of the ranch is livestock production, as well as remnants of low tropical thorn forest and low tropical dry deciduous forest (Figure 1b).

Once more, on September 22, 2021, at 15:46 hr, we sighted and photographed (D3500, 24.2 MP, Nikon Inc., Tokyo, Japan) another individual of Tamaulipas white-sided jackrabbit (Figure 1c, 1d, 1e) during crocodilian capture activities (A. Silva-Caballero *pers. comm.*) in the vicinity of a thermoelectric plant (AES TEG Operation S de R. L. de C. V.; Figure 1f), eastern Tamuín, San Luis Potosí (22° 03′ 38.01″ N, 98° 50′ 11.83″ W, 45 m; Figure 2). The sighting took place on a paved road close to a railroad track, we were driving a vehicle through some farm plots when we sighted the jackrabbit on the side of the road in a little depression approximately 10–20 m away from us. The surrounding vegetation type in the area are cultivated grasslands, secondary vegetation and remnants of low tropical thorn forest (Figure 1f). This second sighting of the Tamaulipas white-sided jackrabbit ocurred approximately 30.5 km south of the 2016 sighting.

We corroborated the identification of the Tamaulipas white-sided jackrabbit individuals by its coloration,

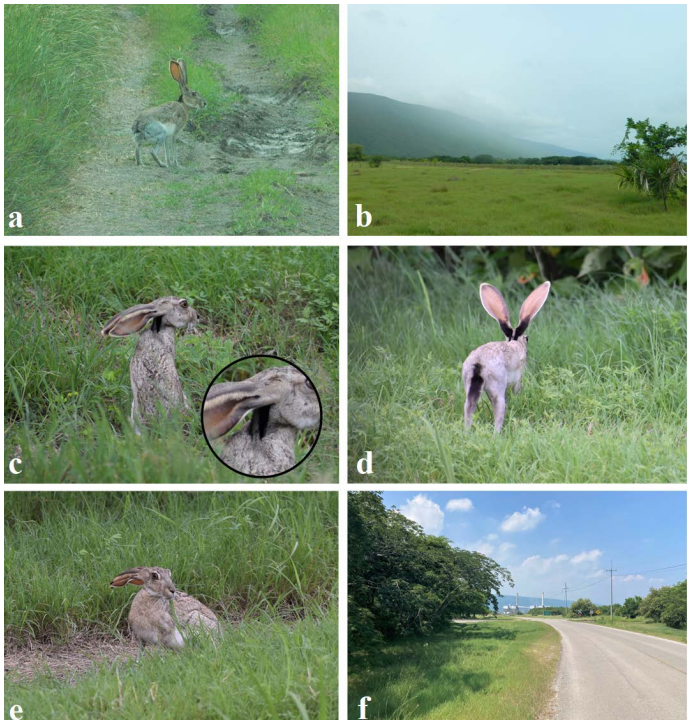

Figure 1. a) Photograph documenting the Tamaulipas white-sided jackrabbit (*Lepus altamirae*) in Tamuín, San Luis Potosí on October 13, 2016. b) Panoramic view of the sighting site in the lowlands of the Huasteca Potosina, México. c), d) and e) Photographs documenting the Tamaualipas white-sided jackrabbit (*Lepus altamirae*) in Tamuín, San Luis Potosí on October 22, 2021. f) Panoramic view of the sighting site in the vicinity of a thermoelectric plant in Tamuín, San Luis Potosí, México.

morphological characteristics, and the distribution of the species (Nelson 1904, 1909; Vargas *et al.* 2019). The photographed individuals of the Tamaulipas white-sided jackrabbit had a straw-grayish fur with conspicuous paler buffy flanks, two black stripes on the nape and a black tail. It also has elongated limbs and ears, the latter without black tips (Figure 1a, 1c, 1d, 1e). Our presence (the approach with the vehicles) probably favored the encounters, since in general, the jackrabbits rest during the day in a "shelter form" usually surrounded by dense clumps of tall grass (Best and Henry 1993; Leopold 2000; Reid 2006).

The only previous record of the species, and the type locality, is 98 km east at Altamira, Tamaulipas (USNM:92981; United States National Museum). Most reports of jackrabbit species in the state of San Luis Potosí are restricted to the Potosino-Zacatecano Plateau (Dalquest 1953; Martínez-Calderas *et al.* 2016; Martínez de la Vega *et al.* 2016; Brown *et al.* 2018b, 2018c). Moreover, recent mammal studies in northeastern San Luis Potosí did not record the presence of the Tamaulipas white-sided jackrabbit or any other jackrabbit species (Hernández-SaintMartín and Rosas-Rosas 2014; Martínez-Hernández *et al.* 2017; Del Río-García *et al.* 2020; Sahagún-Sánchez and De-Nova 2020).

We identified the Tamaulipas white-sided jackrabbit individual according to its coloration, morphological characteristics, and the distribution of the species, supported by the exhaustive review that we made in several sources. Even though the coloration could resemble the black-tailed jackrabbit (*L. californicus*), the sides of the latter tend to be brownish-gray and has black-tipped ears (Best 1996; Leopold 2000; Reid 2006; Cervantes and Hernández 2014). In contrast, the sides of the Tamaulipas white-sided jackrabbit are paler buffy and do not have black ear tips (Nelson 1904, 1909).

Furthermore, although the Tamaulipas white-sided jackrabbit was classified in the group of black-tailed jackrabbits (Hall 1951; Álvarez 1963), it was mentioned that in the state of Tamaulipas this taxon could present white flanks, and in some cases the lack of the black spot on the ears (Hall 1951, 1981; Best 1996), which could suggest an imprecise taxonomic classification (Vargas *et al.* 2019). Likewise, the distribution of the black-tailed jackrabbit within the state of San Luis Potosí is limited to the Potosino-Zacatecano Plateau (Ceballos *et al.* 2006; Cervantes and Hernández 2014; Farías *et al.* 2015b; Martínez-Calderas *et al.* 2016; Martínez de la Vega *et al.* 2016; Brown *et al.* 2019).

On the other hand, although the coat coloration of the individuals registered is also very similar to that of the white-sided jackrabbit (*Lepus callotis*), a reason for which several authors have placed *L. altamirae* in the white-sided group of jackrabbits (Nelson 1909; Vargas *et al.* 2019), the limbs of *L. callotis* tend to be whiter and the sides are pure white (Best and Henry 1993; Reid 2006; Cervantes *et al.* 2014; Brown *et al.* 2018b). Besides, the photographed individuals of the Tamaulipas white-sided jackrabbit had two black stripes on the nape, a characteristic that is not reported in the abovementioned jackrabbit species.

Our records are unique for the species in the state of San Luis Potosí, and they are the first records after a century of the species description (Nelson 1904). At the same time, our records support recent genetic findings (Vargas *et al.* 2019), which suggest the taxonomic restoration as a species of *L. altamirae* within the white-sided group of jackrabbits. Even more, Vargas *et al.* (2019) claim that from a biogeographic point of view, it seems more consistent to have a white-sided jackrabbit in tropical-subtropic Tamaulipas, an area that borders the Huasteca Potosina.

The Tamaulipas white-sided jackrabbit´s sighting sites are located in areas of cattle management and farm plots, which are adjacent to a Natural Protected Area (Reserva de la Biosfera Sierra del Abra Tanchipa). Additionally, these locations are nearby to several Wildlife Management Units (UMAs, from its name in Spanish), which together probably influences the presence of the Tamaulipas white-sided jackrabbit in the area. Despite the fact that mammal studies have been carried out in the area for more than 10 years (mainly in the Reserva de la Biosfera Sierra del Abra Tanchipa; Villordo-Galván *et al.* 2010; Hernández-SaintMartín and Rosas-Rosas 2014; Martínez-Hernández *et al.* 2017; Del Río-García *et al.* 2020), and although some included sites close to where we registered the Tamaulipas white-sided jackrabbit (Sahagún-Sánchez and De-Nova 2020), no one had reported any similar record.

The coastal plain of the Gulf of México is a physiographic province with high biodiversity (Caso *et al.* 2004) that still maintain areas with adequate habitats for medium and

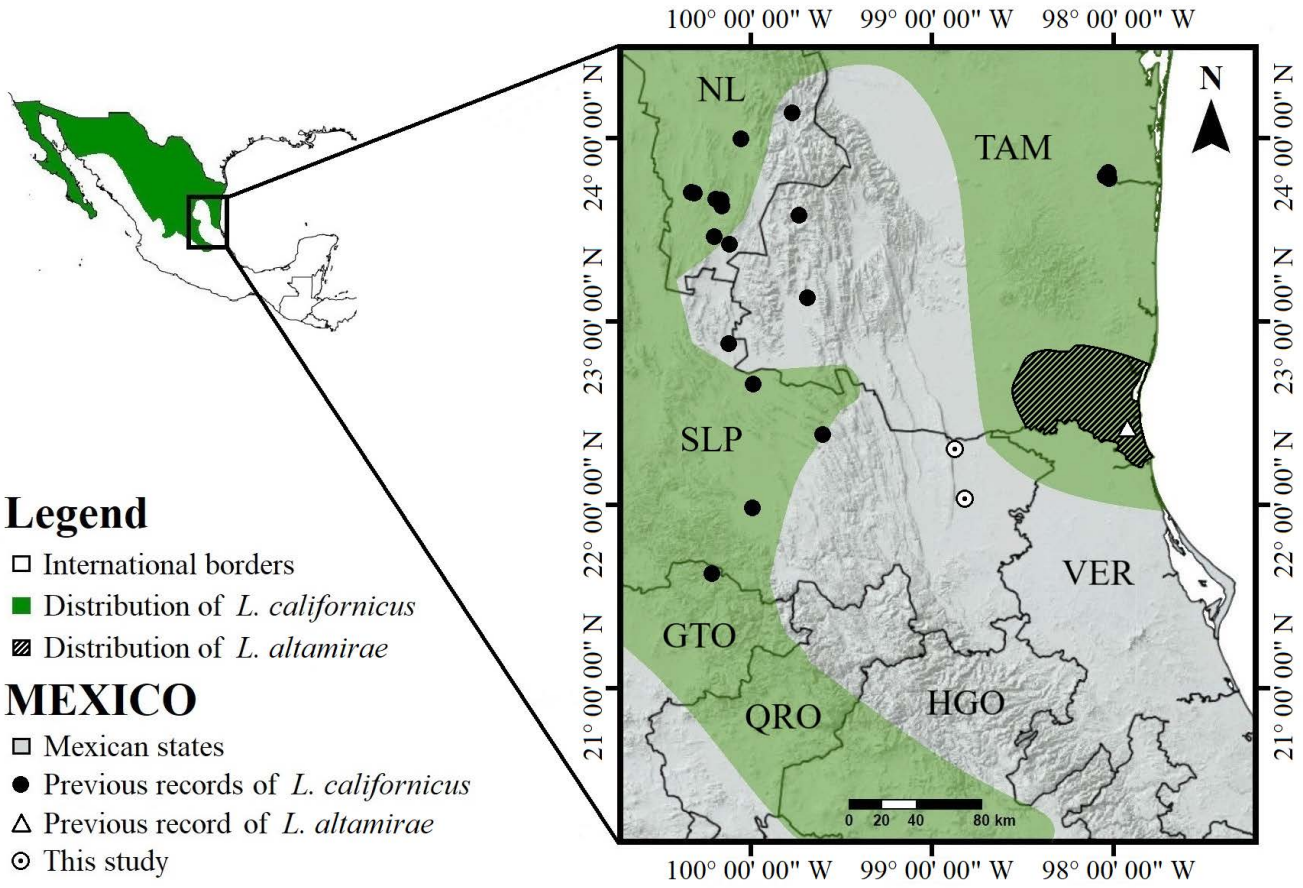

Figure 2. Firsts records of the Tamaulipas white-sided jackrabbit, *Lepus altamirae* (white dots) in the lowlands of the Huasteca Potosina, México, and literature record of the species (white triangle) and *Lepus californicus* in northeast México (black dots). Distribution of *L. altamirae* (black lines) according to Nelson (1909), and distribution of *L. californicus* (green) redrawn from Cervantes and Hernández (2014). Mexican states: GTO = Guanajuato; HGO = Hidalgo; NL = Nuevo León; QRO = Querétaro; SLP = San Luis Potosí; TAM = Tamaulipas; VER = Veracruz.

small mammals (Martínez de la Vega *et al.* 2016). Even though it is considered that the jackrabbits' populations have decreased elsewhere (Brown *et al.* 2018c; Brown and Smith 2019; Schlater *et al.* 2021) the presence of this species in the region could be related to cultivated grasslands and remnants of vegetation (Brown *et al.* 2018a). Nevertheless, due the high rate of land use change in the region (Reyes *et al.* 2014; E. Painter *pers. comm.*), it is necessary to establish systematic monitoring to improve the knowledge of the distribution of this and other mammal species in the lowlands of the Huasteca Potosina. Further studies should involve additional records and also molecular biology techniques to elucidate the population trend and ecology of the Tamaulipas white-sided jackrabbit in the area.

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