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New records for the gray mouse opossum (*Tlacuatzin canescens*) in Sonora, México

Nuevos registros de tlacuache ratón gris (*Tlacuatzin canescens*) en Sonora, México

Carmina E. Gutiérrez-González[1]*, Elise Kelley[2], Miguel Á. Gómez-Ramírez[1], and Federico Mora-Carrillo[1]

[1]Northern Jaguar Project. 2114 West Grant Road Suite 121, ZIP code 85745. Tucson, Arizona, U.S.A. E-mail: carmina.gutierrez.gonzalez@outlook.com (CEG-G); ekim357@gmail.com (MAG-R); latrans.1986@gmail.com (FM-C).
[2]Independent researcher. Hawaii, U.S.A. E-mail: lemurs2017@outlook.com (EK).
*Corresponding author

The gray mouse opossum (*Tlacuatzin canescens*) is one of the smallest marsupials in México. It is found primarily along the Pacific littoral zone and the neighboring coastal mountain range, from Alamos, Sonora southward to Oaxaca and Chiapas, as well as in isolated populations on the Tres Marias Islands and in the northern part of the Yucatán Peninsula. The new records of *T. canescens* were mainly acquired from long-term motion-triggered camera monitoring on the Northern Jaguar Reserve and ranches participating in the Viviendo con Felinos® program, which monetarily compensates ranchers for supporting the protection of wildlife, especially felines on their property. We documented 7 new records of *T. canescens* in Sahuaripa, Sonora. Three motion-triggered camera records, 3 dead encounters, and 1 live encounter in the Northern Jaguar Reserve obtained between 2015 and 2020. The new *T. canescens* records correspond to a northward range expansion for the species of at least 240 km beyond the previously known species' range. The Northern Jaguar Reserve, whose mission is to protect part of the northern jaguar (*Panthera onca*) population, also represents a refuge for smaller species such as the gray mouse opossum, which is a Mexican endemic marsupial.

Key words: Northern Jaguar Reserve; range extension; Sahuaripa; Viviendo con Felinos®.

El tlacuache ratón gris (*Tlacuatzin canescens*) es uno de los marsupiales más pequeños de México. Se le encuentra a lo largo del litoral del Pacífico desde la región de Álamos, Sonora hasta Oaxaca y Chiapas. También en poblaciones aisladas en las Islas Tres Marías y al norte de la Península de Yucatán. Los nuevos registros de *T. canescens* fueron obtenidos principalmente de un monitoreo con cámaras automáticas en la Reserva Jaguar del Norte® y un rancho que participa en el programa Viviendo con Felinos®, el cual compensa monetariamente a los dueños por apoyar la protección de la vida silvestre en su propiedad, especialmente felinos. Se documentaron 7 registros de *T. canescens* en Sahuaripa, Sonora. Tres registros son de cámaras automáticas, 3 corresponden a animales que fueron encontrados muertos, y 1 avistamiento de un ejemplar vivo en la Reserva Jaguar del Norte® entre 2015 y 2020. Estos nuevos registros de *T. canescens* corresponden a una extensión de distribución para la especie en por lo menos 240 km al norte del rango de distribución antes conocido. La Reserva Jaguar del Norte®, cuya misión es proteger parte de la población más norteña de jaguares (*Panthera onca*), también representa un refugio para especies menores como el tlacuache ratón gris, el cual es un marsupial endémico de México.

Palabras clave: Ampliación de distribución; Reserva Jaguar del Norte®; Sahuaripa; Viviendo con Felinos®.

The gray mouse opossum (*Tlacuatzin canescens*) formerly known as *Marmosa canescens* (Voss and Jansa 2003) is one of the smallest marsupials in North America (Ceballos and Oliva 2005), and 1 of 8 marsupials found in México (Medina-Romero *et al.* 2012). This species is endemic to México (Zarza *et al.* 2003) and is listed in the Mexican Official Norm NOM-059-SEMARNAT-2010 (SEMARNAT 2019). This is the official document that lists the threatened plants and animals in México. *Tlacuatzin canescens* is listed as Least Concern by the International Union for Conservation of Nature (IUCN; Martin 2017), but there is limited information about the status of their populations.

Tlacuatzin canescens is primarily found along the Pacific littoral zone and the neighboring coastal mountain range from Sonora southward to Oaxaca and Chiapas (Voss and Jansa 2003; Zarza *et al.* 2003), as well as in isolated populations on the Tres Marias Islands and in the northern part of the Yucatán Peninsula (Voss and Jansa 2003; Zarza *et al.* 2003; Reid 2009). Within its range, the gray mouse opossum occupies a diversity of habitats from agricultural lands, scrublands (Zarza *et al.* 2003; Reid 2009), dry hills (Reid 2009) and savanna-like grasslands, to semi-deciduous (Zarza *et al.* 2003), deciduous (Voss and Jansa 2003; Zarza *et al.* 2003; Reid 2009), tropical evergreen (Voss and Jansa 2003) and secondary forests (Voss and Jansa 2003; Zarza *et al.* 2003; Ceballos and Oliva 2005). *Tlacuatzin canescens* is typically associated with pristine habitat and although it has been found in fragmented and disturbed habitats (Ibarra-Cerdeña *et al.* 2007), research is limited and is inconclusive as to whether it can thrive in such

environments. The upper elevational limit for *T. canescens* is 2,300 m (Ceballos and Oliva 2005; Reid 2009), but it is most frequently found below 1,000 m (Ceballos and Oliva 2005).

Tlacuatzin canescens is nocturnal and scansorial (Ceballos and Oliva 2005), typically relying on nests in bushes and trees as a place to hide and rest during the day (Ceballos 1990); however, individuals of this species may spend more time on the ground compared to other mouse opossum species like those in the *Marmosa* and *Marmosops* genus (Reid 2009). We present new records of *T. canescens* in east-central Sonora, México, in the municipality of Sahuaripa.

The new records of *T. canescens* were found within the Northern Jaguar Reserve and a nearby cattle ranch in the east-central region of the state of Sonora, México (Figure 1). The reserve covers an area of 230 km^2 and due to its isolated location has minimal human impact. The Pilares y La Sierpe cattle ranch is a member of the Viviendo con Felinos® program which monetarily compensates ranchers for photographs of wildlife, especially living felines on their ranches, and for supporting the protection of wildlife on their property. The combined area of the reserve and participating ranches constitutes a conservation area exceeding 700 km^2.

The vegetation in the area is a heterogeneous mosaic of mostly xerophilous and subtropical thorn scrub, relicts of tropical deciduous forest, and riparian vegetation. Oak woodlands and natural grasslands are present at elevations above 1,000 m. This vegetation is interspersed within large areas of non-native buffel grass (*Pennisetum ciliare*; Felger *et al.* 2001; Gutiérrez-González *et al.* 2015). Mean annual precipitation is 400 mm with winter rains accounting for 18 % of the annual total rain. The mean annual temperature varies from 16 °C in winter to 30 °C in summer, with extreme temperatures ranging between –7 °C and 43 °C (Brown 1994; García and Conabio 1998).

To study part of the northernmost breeding jaguar (*Panthera onca*) population, the Northern Jaguar Reserve and surrounding cattle ranches have been monitored since late 1999 (Gutiérrez-González *et al.* 2015). The quantity of cameras deployed, and the camera locations varied over time depending on access to the properties. The camera brands and models used depended upon equipment availability and include Cuddeback Capture and Attack (Non-Typical Inc., Green Bay, WI, USA) and Stealth cam (GSM Outdoors, Irving, TX, USA). For a more complete description of the camera monitoring design, see Gutiérrez-González *et al.* (2015). With few exceptions, locations selected for cameras were chosen to maximize the detection of felines with an emphasis on capturing photos of jaguars. In 2019, two motion-triggered cameras were installed in 3 trees to specifically detect individuals of *T. canescens*. To improve detection probabilities, these cameras were baited with a mixture of oats and peanut butter. Other camera-traps were located for jaguar monitoring and were not baited. Cameras installed to specifically detect *T. canescens* were deployed in tree branches at least 1 m above the ground. Bait was located in front of the cameras to improve chances of detection. During regular road maintenance work within the Northern Jaguar Reserve, field workers sighted and photographed 2 dead, small, mouse-like mammals.

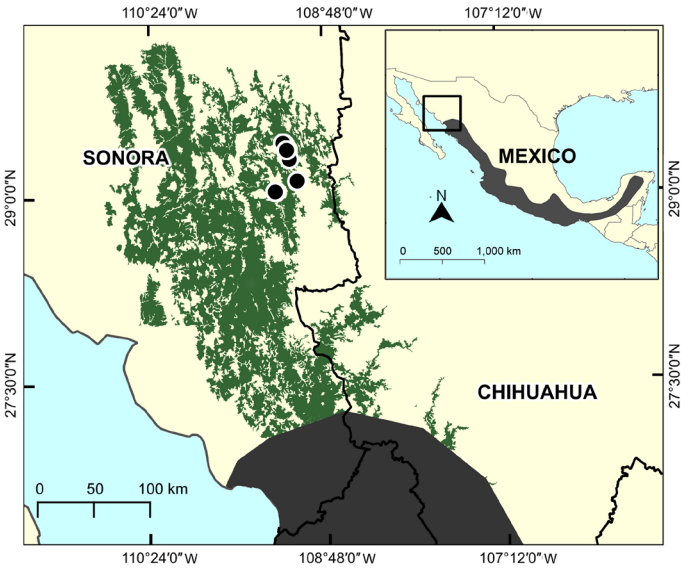

Figure 1. *Tlacuatzin canescens* records in Sonora, México (dots) compared with the northern distribution reported for the species (dark gray). Green shows tropical deciduous forest patches where the species can potentially be present.

We documented the first records of *T. canescens* in the eastern part of the state of Sonora, México. Camera-traps recorded *T. canescens* on June 21, 2015, and May 12, 2019, on the Northern Jaguar Reserve, and on September 17, 2017, on the Pilares y la Sierpe Ranch. Two dead *T. canescens* were found on the reserve, 1 on November 18, 2018, and 1 on November 3, 2019, while performing regular maintenance on conservation lands. Another dead individual was recorded on February 1, 2019, in an area adjacent to the town of Sahuaripa. Due to the body decomposition, it was not possible to collect the individuals for biological collection or to recover the skull or bones. One living *T. canescens* was observed and photographed on May 21, 2020. Coordinates and notes of each encounter are shown in Table 1 and photographic records are shown in Figure 2.

We present 7 records of *Tlacuatzin canescens* from Sonora, México that extend the northern range of the species by 240 km by air from its previously documented location (Voss and Jansa 2003; Zarza *et al.* 2003; SEMARNAT 2015). Since the camera monitoring was not designed to detect *T. canescens* or any other small species, it was impossible to determine the density of the gray mouse opossum within the conservation area. While little is known about the ecology and distribution of the species, it appears to adapt to fragmented and human-dominated landscapes (Ceballos and Oliva 2005). It is possible that additional individuals may be found farther north (Ceballos and Oliva 2005). The gray mouse opossums referenced in this paper were found in areas associated with tropical vegetation, such as tropical deciduous forest, with sufficient vegetation cover and resources for the species to thrive (Ceballos and Oliva 2005).

The gray mouse opossum is an important pollinator for some plants like *Stenocereus queretaroensis* and *Agave cupreata* (Ibarra-Cerdeña *et al.* 2007; Arreola-Gómez and Mendoza 2020). Other species of *Stenocereus* and *Agave* are present in our study area; however, no information is available about the interactions of these species. While the Northern Jaguar Reserve and surrounding cattle ranches currently provide a safe habitat for *T. canescens*, climate change, and habitat fragmentation outside our study area, may impact the future distribution of the species.

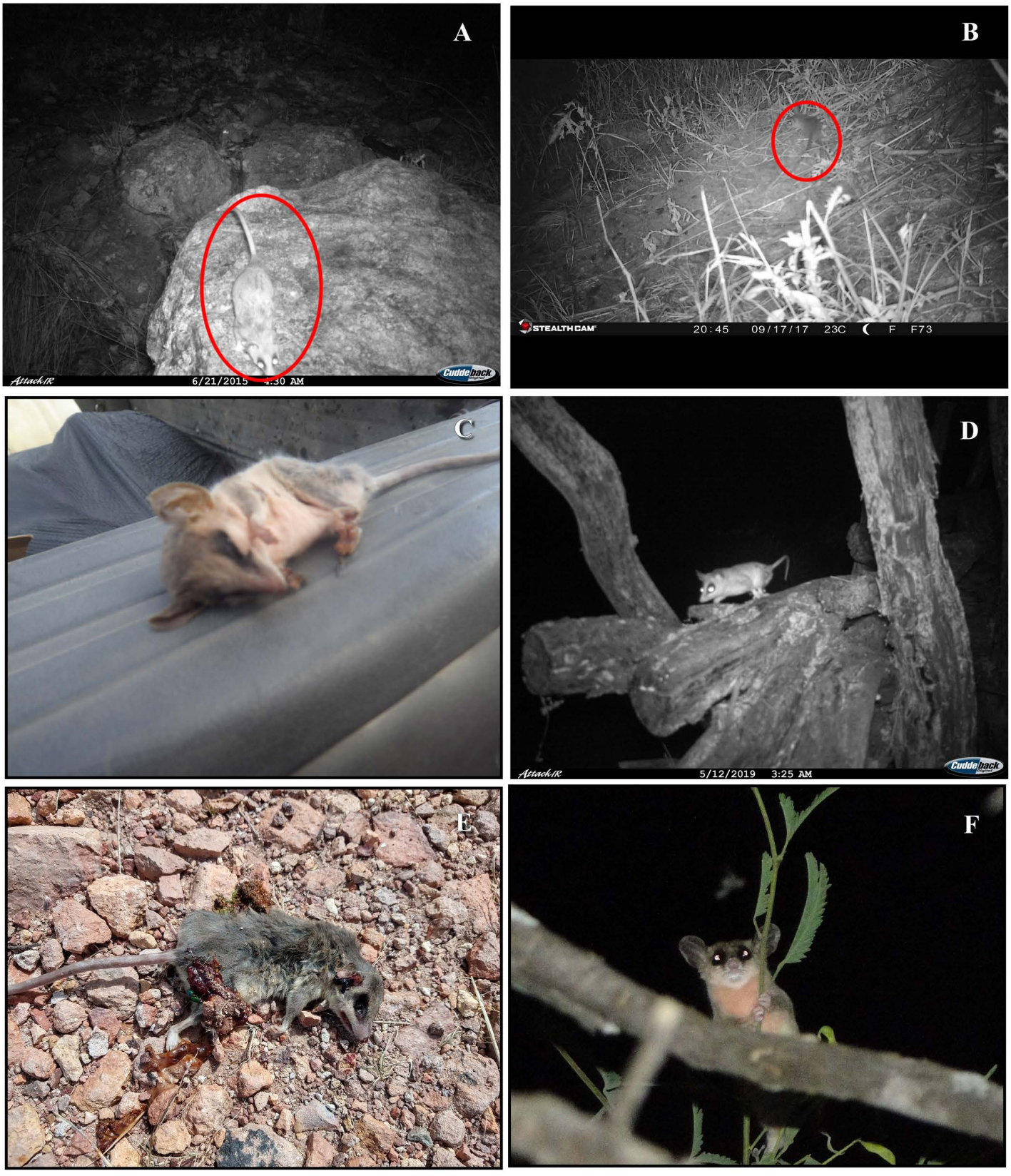

Figure 2. Photographs of each *Tlacuatzin canescens* encounter or detection during 2015-2020. Letters in the figure correspond to each encounter. The related data can be found in Table 1. Camera-trap records are circled in red for easier visualization.

Table 1. Detailed records of *Tlacuatzin canescens* that extends its distribution range in Sonora, México. See corresponding photographs in Figure 2.

Date	Notes	Picture
June 21, 2015	Record type: Motion-triggered camera photograph.	A
	Coordinates: 29° 23′ 3.36″ N, 109° 8′ 15.15″ W.	
	Altitude: 959 m.	
	Vegetation: Oak woodland.	
	Location: Northern Jaguar Reserve.	
	Photo credit: Northern Jaguar Project/Naturalia.	
September 17, 2017	Record type: Motion-triggered camera photograph.	B
	Coordinates: 29° 8′ 15.79″ N, 109° 2′ 27.03″ W.	
	Altitude: 1,216 m.	
	Vegetation: Gallery forest.	
	Location: Pilares y la Sierpe Ranch.	
	Photo credit: Asociación Conservación del Norte/Northern Jaguar Project.	
November 18, 2018	Record type: Dead specimen.	C
	Coordinates: 29° 26′ 29.52″ N, 109° 9′ 29.58″ W.	
	Altitude: 590 m.	
	Vegetation: Mesquite.	
	Location: Northern Jaguar Reserve.	
	Photo credit: Braulio Duarte López.	
February 1, 2019	Record type: Dead specimen.	No photo
	Coordinates: 29° 3′ 22.14″ N, 109° 14′ 21.54″ W.	
	Altitude: 456 m.	
	Vegetation: Mesquite.	
	Location: Sahuaripa, Sonora.	
	Observer: Heraclio Duarte López.	
May 12, 2019	Record type: Motion-triggered camera photograph.	D
	Coordinates: 29° 23′ 51.65″ N, 109° 7′ 34.65″ W.	
	Altitude: 700 m.	
	Vegetation: Mesquite.	
	Location: Northern Jaguar Reserve.	
	Photo credit: Asociación Conservación del Norte/Northern Jaguar Project.	
November 3, 2019	Record type: Dead specimen.	E
	Coordinates: 29° 20′ 23.65″ N, 109° 7′ 31.49″ W.	
	Altitude: 1,040 m.	
	Vegetation: Oak woodland.	
	Location: Northern Jaguar Reserve.	
	Photo credit: Miguel A. Gómez-Ramírez.	
May 21, 2020 21:30 hr (UTC -7)	Record type: Visual encounter of a live specimen.	F
	Coordinates: 29° 23′ 35.94″ N, 109° 8′ 22.31″ W.	
	Altitude: 740 m.	
	Vegetation: Gallery forest.	
	Location: Northern Jaguar Reserve.	
	Photo credit: Federico Mora-Carrillo.	

Tlacuatzin canescens is the only mammal endemic to México found within the Northern Jaguar Reserve. As such, its discovery adds conservation value to the area that includes jaguar, ocelot (*Leopardus pardalis*), neotropical river otter (*Lontra longicaudis*), badger (*Taxidea taxus*), Mexican long-tongued bat (*Choeronycteris mexicana*), and Crawford's gray shrew (*Notiosorex crawfordi*; Flesch *et al.* 2020).

Additional camera-trapping efforts with a focus on small mammals could provide more evidence of the presence of the gray mouse opossum within the Northern Jaguar Reserve as well as the discovery of additional species, which could serve as indicators of habitat quality. Adding regular trapping would permit the sampling of some specimens for biological collections. Due to body decomposition, it was not possible to obtain additional information from these specimens; however, despite their decomposed state, reporting such findings can be valuable in determining current species distribution.

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