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A new locality record and distribution of *Caluromys derbianus* in México

Nuevo registro y distribución de *Caluromys derbianus* en México

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The Derby's wooly opossum, *Caluromys derbianus*, is regarded in México as a rare, threatened mammal species that inhabits tropical forests. It has been recorded in only 14 localities over the past 10 years and, thus, any new locality record helps to better elucidate its geographic distribution. This study aimed at describing the roadkill of a *C. derbianus* individual and mapping the geographic range of *C. derbianus* in México based on current and historical records. An adult *C. derbianus* female was roadkilled on 27 August 2019 in the Peñuela town, municipality of Amatlán de Los Reyes, state of Veracruz, México. Peñuela is a semi-urban area characterized by the presence of secondary vegetation and a tributary of the Río Blanco river. This unusual record, given the low population density of this species, confirms its presence in a previously unrecorded locality within its potential distribution range and helps to understand the effects of disturbance and fragmentation of the sub-evergreen tropical forest on the habitat of this species.

Key words: Derby's wooly opossum; Didelphidae; roadkill; sub-evergreen tropical forest.

En México, el tlacuachillo dorado (*Caluromys derbianus*) se considera un mamífero raro y amenazado que habita bosques tropicales. En los últimos 10 años, su presencia se ha registrado en 14 localidades, por lo que un nuevo registro contribuye a describir aspectos de su distribución geográfica. El objetivo del estudio fue registrar las características del atropellamiento de un ejemplar de *C. derbianus* y describir su área de distribución geográfica en México con base en registros históricos y actuales. El día 27 de agosto de 2019 se registró una hembra adulta de *C. derbianus* atropellada en la localidad de Peñuela, municipio de Amatlán de Los Reyes, Veracruz, México, localidad que se caracteriza por ser un área semiurbana, con presencia de vegetación secundaria y un arroyo tributario del Río Blanco. Este registro, poco habitual por la baja densidad poblacional de la especie, confirma su presencia en una localidad no conocida dentro de su área de distribución potencial y ayuda a entender el efecto de la perturbación y fragmentación del bosque tropical subperennifolio sobre el hábitat de esta especie.

Palabras clave: Bosque tropical subperennifolio; colisión; Didelphidae; tlacuachillo dorado.

Mammals exhibit dynamic geographic ranges that vary spatially and temporally. Records of the occurrence of a species in previously unreported localities within its potential distribution range help to better understand the processes of colonization of new habitats and advance the knowledge on the geographic distribution and biogeographic history of the taxon (Zunino and Zulini 2003). Some individuals of a population frequently move to new geographic areas in search of habitats suitable for their survival, thus increasing the probability of their being recorded in previously unreported localities within their potential distribution range. Documenting these events is essential for enhancing the knowledge of the geographic range of the species (Galindo-Aguilar *et al.* 2019).

The family Didelphidae (Order Didelphimorphia) is represented in México by 8 species (Sánchez-Cordero *et al.* 2014; Arcangeli *et al.* 2018), some of which typically present a structure known as marsupium (Ramírez-Pulido *et al.* 2014). Most species in this family face serious threats to their demography and genetic structure due to habitat loss (Medina-Romero *et al.* 2012), so that strategies for their conservation are urgently required. *Caluromys derbianus* (Waterhouse 1841) is a threatened (SEMARNAT 2019), low-abundance (Sánchez-Cordero *et al.* 2014) species. Although its potential distribution range is well documented (Gómez-Nísino 2006), any new record from a previously unreported locality within its potential distribution range confirms its presence and has implications for the biogeographic history of the taxon and its conservation (Ortega *et al.* 2021).

Caluromys derbianus, commonly known as tlacuachillo dorado, Derby's wooly opossum, or Central American woolly opossum (Bassa-Hernández *et al.* 2016), is a nocturnal, arboreal, solitary, medium-sized mammal. It is characterized by a coat bearing a greyish-whitish, long-haired, woolly section on the sides of the body, three orange-golden patches on the neck and shoulders, and large pink ears (Gómez-Nísino 2006). Bucher and Hoffmann (1980) concluded that *C. derbianus* comprises seven distinct subspecies; however, Fonseca and Astúa (2015) failed to find geographic differences in cranial traits to support the existence of subspecies. The geographic distribution of *C. derbianus* ranges from south-central Veracruz (México) to eastern Colombia and northern Ecuador (Bucher and

Hoffmann 1980); its potential distribution ranges from central México to South America (Emmons and Feer 1997) including Belize, Guatemala, Honduras, Nicaragua, Panamá, Colombia, Costa Rica, and Ecuador (Solari and Lew 2015). The potential distribution of *C. derbianus* in México comprises the north of Veracruz, eastern Puebla, Tlaxcala, southeast Oaxaca, and parts of the states of Campeche, Chiapas, Tabasco, and Quintana Roo (Solari and Lew 2015). This species has been usually recorded in protected areas in the states of Chiapas: Selva Lacandona (Medellín 1994), Laguna Bélgica (Riechers-Pérez 2004), and La Sepultura (Espinoza-Medinilla *et al.* 2004); Oaxaca: Selva Zoque and Los Chimalapas (Lira-Torres and Briones-Salas 2012); and Veracruz: Sierra de Los Tuxtlas (González-Christen 2008; González-Christen and Coates 2019).

Globally, *C. derbianus* is regarded as a species of least concern since there is no evidence of decreasing population size across its geographic range, although their populations are known to be declining (Solari and Lew 2015). Anthropogenic activities have caused major ecological changes and impacts on ecosystems in recent decades. The major driving force has been land-use change caused by urbanization for human settlements and industry, development of transport infrastructure, and agricultural activities, all of which have impacted the habitats and populations of numerous mammal species (Briones-Salas *et al.* 2016). Fragmentation and disturbance reduce habitat suitability, which might alter the migration and demographic patterns of mammal populations, as individuals are forced to move away from disturbed habitats where competition for resources and space is intense, towards habitats with more conducive environment (Cruz-Bazán *et al.* 2017). This also increases the number of wildlife that cross highways, freeways, and main or secondary streets, increasing their risk of dying by vehicular collision (González-Gallina and Benítez-Badillo 2013; González-Gallina *et al.* 2013). This study aimed at describing the roadkill of a *C. derbianus* individual and mapping the known geographic distribution of this species in México, based on occurrence records obtained from electronic databases.

Record of the roadkill of a *C. derbianus* individual. On 27 August 2019 at approximately 15:20 hr, a *C. derbianus* specimen (Figure 1a) was found dead at coordinates 18° 51′48″N, 96° 54′00″W. The corpse was on the ground next to the pavement of a secondary road that connects the semi-urban area of the Peñuela town (where agriculture is the main land use, including various crops such as banana, coffee, tropical fruit trees, and sugar cane; Figure 1b) with the main highway to the municipal capital Amatlán de Los Reyes, state of Veracruz, some 500 m north from the facilities of the Facultad de Ciencias Biológicas y Agropecuarias (Faculty of Biological and Farming Sciences) at Universidad Veracruzana. The corpse was rigid, had whitish eyes, and had been colonized by ants, fly larvae, and flies. The specimen was identified as an adult female in lactating condition, as it had hairless dugs. Standard body measurements of the specimen were taken in triplicate and averaged (Ceballos and Oliva 2005; Romero-Almaráz *et al.* 2010), with the following results: 549 mm total length, 343 mm length of vertebral tail, and 262 mm length of rear right leg. Features such as salmon-pink colored ears and nose, golden coloration on the sides with a whitish belly, and hairy tail, dark brown at the base that faded into white-bone coloration at the tip (Figure 1a), coincided with those described by Aranda (2012) and Gómez-Nísino (2006).

The skin, skull, and axial skeleton of the specimen were preserved and deposited under accession number IIB-UV 4322 in the Veracruz Mammal Collection (registry number VER.-MAM-191-10-06 SEMARNAT) of the Instituto de Investigaciones Biológicas (Institute of Biological Research) at Universidad Veracruzana.

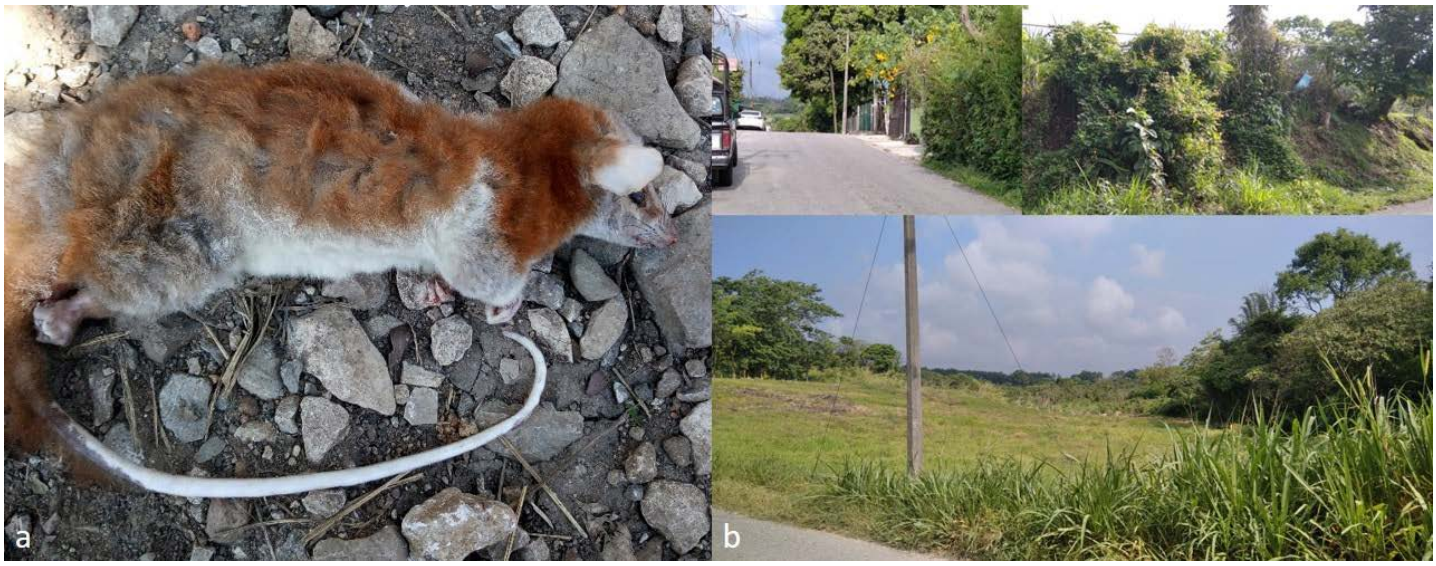

Figure 1. a) Female specimen of the Derby's wooly opossum, *Caluromys derbianus*, roadkilled in Peñuela town, Amatlán de los Reyes, Veracruz, México; b) habitat in the locality where the roadkill of *C. derbianus* occurred.

Known distribution of *C. derbianus* in México. Current (15 records dating from 1989 to 2019, GBIF 2019a) and historical (70 records dating from 1900 to 1988; GBIF 2019b) occurrence records, retrieved from the Global Biodiversity Information Facility database (GBIF 2019c), were used to map the known distribution of *C. derbianus* in México. Records providing geographic coordinates were included in the map, as they helped to understand how the species distribution has been affected spatially and temporally, either reducing its distribution range or by causing displacements to new sites leading to the expansion of its range (Zunino and Zulini 2003). Only 47 (67 %) of the 70 historical records (visual observations and records retrieved from the GBIF database) of *C. derbianus* in México provided geographic coordinates of collection localities; 34 % (16) of those correspond to the state of Veracruz, 23 % (11) to Chiapas, 19 % (9) to Tabasco, 11 % (5) to Quintana Roo, 8.5 % (4) to Campeche, 4.3 % (2) to Oaxaca, and one to San Luis Potosí. The oldest record retrieved dates back to the year 1961 and was made in the Sarabia town, state of Oaxaca, México; this can be regarded as the locality where this species was first recorded in México.

Bucher and Hoffman (1980) reported that the distribution limit of *C. derbianus* in México is the south-central part of the state of Veracruz. However, we recorded this species in the central-western part of the state of Veracruz, thus expanding its known distribution range by approximately 20 km to the west, where the mountain cloud forest, tropical evergreen forest, and tropical sub-evergreen forests converge (Gómez-Nísino 2006). The records retrieved reported elevations ranging from 0 to 3,600 m; this can be regarded as the altitudinal range encompassed by this species in México. In other countries such as Colombia, this species has been reported to occur from coastal areas up to 2,600 m (Alberico *et al.* 2000).

Of the 15 records of *C. derbianus* deposited in the GBIF database for the 1989-2019 period, 14 (93 %) came from different locations. Nine (65 %) of these records were made in the state of Chiapas at elevations ranging from 36 to 300 m; 6 (42 %) were made in the state of Veracruz, and 2 (14 %) in the state of Tabasco, but these did not include information on vegetation type or elevation. The distribution map of *C. derbianus* shows that the northernmost record is located in the state of San Luis Potosí, México, and that the records are concentrated along the Sierra Madre Oriental mountain range (Figure 2). The new record of this species falls amid a set of historical records. Thus, future studies should further investigate demographic aspects and characterize the

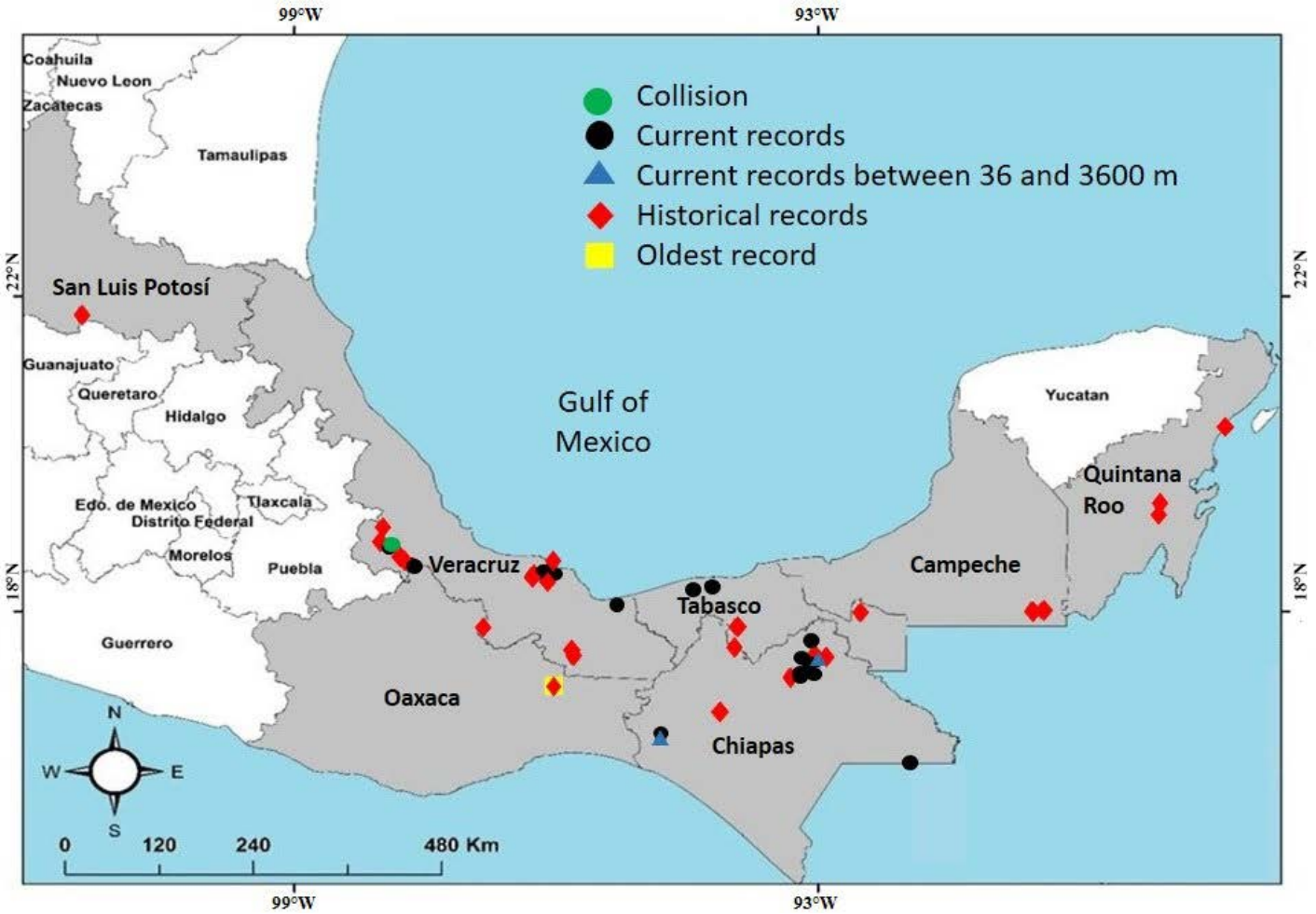

Figure 2. Geographic location of historical (scientific collections) and recent (GBIF database) records of the Derby's wooly opossum, *Caluromys derbianus*, in México. Mexican states shown in gray are those where this species has been recorded.

habitat of this species to help formulate and implement specific actions for conservation. The presence of *C. derbianus* is usually associated with coffee, banana, and cocoa plantations (Marineros-Sánchez *et al.* 2016), as confirmed in the field in the area surrounding the locality where the roadkill occurred. Most recent records of these marsupials have been made near human settlements, as this species rapidly adapts to disturbed places, making encounters with them to be frequent (Hillman and Thompson 2016).

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