

Current distribution of the Mexican hairy dwarf porcupine, *Sphiggurus mexicanus*, in Guerrero, México

Distribución actual del puercoespín enano peludo mexicano, *Sphiggurus mexicanus* en Guerrero, México

ANGEL NEFTALI OSORIO-RODRIGUEZ^{1,2*}, ENRIQUE VÁZQUEZ-ARROYO², JOSÉ ALBERTO ALMAZÁN-CATALÁN^{2,3}, DAVID URIOSTEGUI FARIAS², ALEJANDRO JUÁREZ-AGIS³, AND LUIS ALVIN GARZÓN LÓPEZ⁴

¹Laboratorio Integral de Fauna Silvestre (Área Ornitología), Facultad de Ciencias Químico-Biológicas, Universidad Autónoma de Guerrero. Av. Lázaro Cárdenas s/n., Ciudad Universitaria Sur, C. P. 39090. Chilpancingo de los Bravo, Guerrero, México. E-mail: neftali.eptesicusfuscus@gmail.com (ANO-R).

²Instituto para el Manejo y Conservación de la Biodiversidad A. C. Calle Durango 23, Colonia José Vasconcelos, C. P. 39070. Chilpancingo de los Bravo, Guerrero, México. E-mail: enriquevazquezarroyo@hotmail.com (EV-A); uriostegui601@gmail.com (DUF).

³Escuela Superior de Ciencias Ambientales, Universidad Autónoma de Guerrero. Carretera Cayaco-Puerto Marqués, Ejido Llano Largo Parcela 56, 57 y 58, Campus Llano Largo, C. P. 39906. Acapulco, Guerrero, México. E-mail: inmacob.ac@gmail.com (JAA-C); ajuarezagis@hotmail.com (AJ-A).

⁴Escuela Superior de Ciencias Naturales, Universidad Autónoma de Guerrero. Av. Universidad s/n, Ex Rancho Shalako, C. P. 39105. Chilpancingo de los Bravo, Guerrero, México. E-mail: bioalvinuacn@yahoo.com.mx (LAGL).

*Corresponding author

The Mexican hairy dwarf porcupine, *Sphiggurus mexicanus*, is listed as threatened in the Mexican regulations. It has previously been recorded in three terrestrial ecoregions of the State of Guerrero. However, there are still several regions with no information on this species. The objective of this note is to provide a detailed account of the current distribution of *S. mexicanus* in the State of Guerrero and fill the information gaps on its occurrence information for the poorly studied regions. We searched for reports of *S. mexicanus* in electronic repositories such as Enciclovida, Naturalista, and Global Biodiversity Information Facility, as well as in scientific literature for the State of Guerrero. In addition, we created an updated database that includes recent and unpublished observations, both direct and indirect (skin, bone remains, excreta, barrows, run-over, and hunted specimens). We found a total of 59 records of *S. mexicanus*, of which 24 % are accounts from the literature and electronic repositories collected over the past 60 years. Within our database, 45 records correspond to 16 municipalities in Guerrero that comprise three ecoregions, of which Sierra Madre del Sur has the largest number ($n = 26$) of records. All sightings occurred between 7 and 2,400 m, and 58 % ($n = 26$) of records were either direct sightings or evidence of indirect observations over the past two decades (years 2000–2020). Our new records provide the most comprehensive data set on the distribution of *S. mexicanus* in 11 municipalities with no previous records. We confirmed its presence in a total of 19 municipalities in the State of Guerrero. Most of our records come from temperate forests and dry tropical forests; however, there were occasional sightings on farmland. Our observations mostly corroborated that *S. mexicanus* depends on high plant coverage as it was commonly found in forest habitats. Moreover, based on the results obtained from indirect observations of deceased individuals or their remains, the two major threats to populations of *S. mexicanus* in Guerrero appear to be hunting and running-over (resulting in road death).

Key words: Habitat; mammal; observations; rodent; southwestern México; use of tree species.

El puercoespín enano peludo mexicano *Sphiggurus mexicanus* está catalogado como amenazado por la ley mexicana y ha sido registrado previamente en el estado de Guerrero en tres ecorregiones terrestres. Sin embargo, todavía hay varias regiones sin información sobre esta especie. El objetivo de esta nota es proporcionar una descripción detallada de la distribución actual de *S. mexicanus* en el estado de Guerrero y llenar los vacíos de información de ocurrencia para las regiones poco estudiadas. Buscamos ocurrencias de *S. mexicanus* en repositorios electrónicos como Enciclovida, Naturalista y Global Biodiversity Information Facility, y en la literatura científica publicada para el estado de Guerrero. Adicionalmente, creamos una base de datos actualizada que incluye observaciones recientes e inéditas, tanto directas como indirectas (piel, restos óseos, excretas, púas, atropellados y cazados). Recolectamos un total de 59 registros de *S. mexicanus*, de los cuales el 24 % son ocurrencias extraídas de la literatura y los repositorios electrónicos recogidos en los últimos 60 años. Dentro de nuestra base de datos, 45 registros corresponden a 16 municipios de Guerrero; distribuidos en tres ecorregiones, la Sierra Madre del Sur tiene el mayor número ($n = 26$) de registros. Todos los avistamientos ocurrieron entre altitudes de 7 y 2,400 m y el 58 % ($n = 26$) de los registros corresponden a observaciones directas y evidencias de observaciones indirectas de las últimas dos décadas (2000 – 2020). Nuestros nuevos registros proporcionan el conjunto de datos más completo de la distribución de *S. mexicanus* en 11 municipios sin registros previos. Confirmamos su presencia en un total de 19 municipios del estado de Guerrero. La mayoría de nuestros registros provienen de bosques templados y selvas tropicales secas; sin embargo, hubo avistamientos ocasionales en tierras de cultivo. Nuestras observaciones corroboraron en su mayoría la dependencia de la especie de una alta cobertura vegetal, ya que fue encontrada comúnmente en hábitats arbóreos. Además, con base en los resultados obtenidos de las observaciones indirectas de individuos fallecidos y/o sus restos, las dos mayores amenazas para las poblaciones de *S. mexicanus* en Guerrero parecen ser la cacería y los atropellamientos (que resultan en muerte en carretera).

Palabras clave: Hábitat; mamífero; observaciones; roedor; suroeste de México; uso de especies arbóreas.

The tropical porcupine *Sphiggurus mexicanus* is a medium-sized rodent with a robust body covered mostly by spines and a long tail and prehensile (Juárez-G. 2005; Aranda 2012). It is an arboreal, solitary, and nocturnal species (Aranda 2012) that can have a home range of approximately 10 hectares (Wainwright 2002). In particular, *S. mexicanus* is classified as threatened based on the Mexican legislation (SEMARNAT 2010) and as a minor concern at the international level (Vázquez et al. 2016).

In México, *Sphiggurus mexicanus* is distributed along the two coastal (Gulf and Pacific) slopes, from San Luis Potosí to the Yucatán peninsula and from Michoacán to Chiapas (Juárez-G. 2005), and along the Sierra Madre Oriental (Ramírez-Bravo 2012; Lira-Torres et al. 2014). It has been recorded in various types of vegetation, including coastal dunes (Briones-Salas and Sánchez-Cordero 2004), evergreen and sub-evergreen (Juárez-G. 2005; Lira-Torres et al. 2005; Mejenes-López et al. 2010; Lira-Torres et al. 2014), subtropical and deciduous tropical forests (Briones-Salas and Sánchez-Cordero 2004; Juárez-G. 2005; Lira-Torres et al. 2005; Ramírez-Bravo 2012; Lira-Torres et al. 2014; Lorenzo et al. 2014), temperate forests (Monterrubio-Rico et al. 2010; Lira-Torres et al. 2014), and mountain cloud forests (Juárez-G. 2005; Lira-Torres et al. 2014; Cisneros-Palacios et al. 2015). In addition, it thrives in areas with a certain degree of disturbance (Riechers-Pérez 2004; Fallar-Menéndez et al. 2005; Lira-Torres et al. 2005; Lira-Torres 2006; Barragán et al. 2010; Cisneros-Palacios et al. 2015; Galindo-Aguilar and Lavariega 2019), in an altitudinal range from sea level to 3,200 m (Juárez-G. 2005).

In Guerrero, there are historical records of the presence of *S. mexicanus* in the municipalities of Acapulco de Juárez, Atoyac de Álvarez, Chilpancingo de los Bravo, Juan R. Escudero, Leonardo Bravo, Ometepe, Petatlán, and Zirándaro, located in the terrestrial ecoregions (TE; INEGI-CONABIO-INE 2008): Balsas Depression (BD); Sierra Madre del Sur (SMS); and Planicie Costera y Lomeríos del Pacífico Sur (South Pacific Coastal Plains and Hills; SPCPH), which span across an altitudinal range between 11 and 2,216 m (Leopold 1959; Hall 1981; Lozano-Guzmán 1983; Sánchez-Hernández and Gaviño de la Torre 1988; León-Paniagua and Romo-Vázquez 1991; Jiménez-Almaraz et al. 1993; Almazán-Núñez et al. 2011; Marín et al. 2016; Espinosa-Martínez et al. 2017; Almazán-Núñez et al. 2018; Zavala-Sánchez et al. 2018; Ruiz-Gutiérrez et al. 2020). In Guerrero, the records correspond to low deciduous forest, oak, pine-oak and mountain cloud forests (Leopold 1959; Lozano-Guzmán 1983; Sánchez-Hernández and Gaviño de la Torre 1988; León-Paniagua and Romo-Vázquez 1991; Jiménez-Almaraz et al. 1993; Almazán-Núñez et al. 2011; Marín et al. 2016; Almazán-Núñez et al. 2018; Zavala-Sánchez et al. 2018).

Although there are records of *S. mexicanus* in Guerrero, the information on its distribution is incomplete since there are large areas considered within its potential distribution range, but where its presence has not been reported. As a result, its distribution area may be either over- or underes-

timated. The main objective of this study is to collect and expand the knowledge of the current distribution of *S. mexicanus* in the State of Guerrero, generating new information for the regions lacking data and determining its current distribution more accurately.

Study Area. The State of Guerrero is located in southwest México between coordinates 16° 42' 16.21", 18° 46' 56.73" N and 98° 00' 40.59", 102° 10' 40.20" W. Its territory is part of four terrestrial ecoregions (TE): Trans-Mexican Volcanic Belt (TMVB), Balsas Depression (BD), Sierra Madre del Sur (SMS), and Planicie Costera y Lomeríos del Pacífico Sur (South Pacific Coastal Plains and Hills; SPCPH; INEGI-CONABIO-INE 2008). The State of Guerrero has an elevation range from sea level to 3,550 m. The vegetation types include mountain cloud forest, pine, pine-oak and oak-pine forests, low deciduous tropical forest, medium subdeciduous tropical forest, mangrove forest, and thorny scrubland, as well as secondary vegetation, induced pastures, and crop areas (INEGI 2010).

For the collection of records, reports of *S. mexicanus* occurrence were searched in electronic repositories that included Enciclovida (CONABIO 2019), Naturalista (Naturalista 2019), and Global Biodiversity Information Facility (GBIF 2019). From the reports obtained, those lacking coordinates, poorly georeferenced, or not matching the study area were excluded. Likewise, we conducted a comprehensive scholar Google search of published scientific literature for the State of Guerrero using the keywords: *mamíferos de Guerrero*, mammals of Guerrero, *puerco espín tropical* (tropical porcupine), *puerco espín* (porcupine), porcupine, *Coendou mexicanus*, *Sphiggurus mexicanus*.

In addition, new records of secondary sightings were obtained while carrying out activities related to several research projects on terrestrial vertebrates by the authors. These data were collected through direct sightings of live individuals and indirect observations of specimen signs (skin, bone remains, excreta, spines) and specimens killed by different factors (e.g., run over or hunted by humans and domestic dogs; Figure 1). All historical and recent records were entered in a georeferenced database.

We obtained a total of 59 records of *S. mexicanus*, of which 19 % ($n = 11$) proceeded from the scientific literature published between 1959 and 2020; 5 % ($n = 3$) are data from electronic repositories collected between 1904 and 2019, and 76 % ($n = 45$) corresponds to field sampling over the past two decades (Figure 2; Table 1).

The highest percentage (58 %) of records ($n = 26$) of *S. mexicanus* corresponded to live organisms observed in the field and 42 % ($n = 19$) to dead organisms, of which 24 % ($n = 11$) pertained to run-over and hunted animals (Table 1). The reports of the presence of this species were expanded to 19 municipalities, 3 ecoregions, and 6 vegetation types (Table 1; Figure 2). Among the records of live organisms, the highest percentage (31 %) occurred in low deciduous forests (Table 1). Observations of live organisms were associated with trees of the genera *Annona*, *Cecropia*, *Curatella*, *Enterolobium*, *Ficus*, *Gliricidia*, *Inga*, *Mangifera*,



Figure 1. Photographic evidence of direct and indirect observations of *Sphiggurus mexicanus* in 10 municipalities of Guerrero, México. a) to g) correspond to live organisms, h) to o) correspond to remains of organisms. Individuals with daytime activity observed in tree habitats, associated with humid and tropical forests (a–e). Individuals with nocturnal activity observed below the canopy in a pine forest (f) and associated with human buildings (g). Remains of *S. mexicanus*, spines in the snout of a domestic dog when attacking a porcupine (h); spines, hairs, and skulls of specimens apparently killed by a wild predator (i–k). Specimen as a hunting trophy (l). Specimens ran over in a highway (m) and dirt roads (n–o). © Copyright: b) Concepción Ojeda; e) Contreras Javier; h) Salmerón-Barrera; l) Poblete López.

and *Pithecellobium*, of which *Ficus* and *Mangifera* were most common. Porcupines were recorded in daytime (08:00–18:00 hr), twilight (06:00– 8:00 hr; 18:00–0:00 hr), and nighttime (20:00–06:00 hr) hours, being more common nighttime hours (20:30, 21:00, 22:00, 22:40, 23:00 hr).

There is a lack of studies on wild mammals for the State of Guerrero, particularly for areas that are difficult to access due to topographic, political, and social issues, resulting in poor knowledge of the species and large information gaps about the actual distribution of the species ([Almazán-Cata-](http://Almazán-Cata)

Distribution of Tropical Porcupine in Guerrero, México

Table 1. Database of the new records of *Sphiggurus mexicanus* in Guerrero, México. The numeral corresponds to the record in Figure 2. Ecoregion: BD = Balsas Depression; SMS = Sierra Madre del Sur; SPCPH = *Planicie Costera y Lomeríos del Pacífico Sur* (South Pacific Coastal Plain and Hills). Vegetation: LDTF = Low deciduous tropical forest; C = crops; MSETF = Medium sub-evergreen tropical forest; PF = Pine forest; MCF = Mountain Cloud Forest; OPF = Oak-Pine forest; OF = Oak forest. Type of record: a = sighting; b = hunted; c = bone remains, skin, spines, excreta; d = run over.

No.	Latitude	Longitude	Municipality	Altitude (m)	Ecoregion	Vegetation	Record type	Activity (hr)	General observations
1	18°02'56.23"N	99°45'25.86"W	Cocula	538	BD	C	Direct ^a	07:00	Individual crossing a crop heading toward natural vegetation (LDTF).
2	18°03'20.57"N	101°44'14.69"W	La Unión	137	BD	LDTF	Direct ^a	23:00	Individual climbing the middle part of a <i>parota</i> tree (<i>Enterolobium cyclocarpum</i>).
3	17°44'33.60"N	99°17'54.50"W	Mártir de Cuilapan	1,261	SMS	LDTF	Direct ^a	15:30	Sheltered inside a crack immersed in the ravine.
4	17°40'10.30"N	99°18'33.10"W	Mártir de Cuilapan	1,492	SMS	LDTF	Direct ^a	08:17	Feeding on a <i>Ficus</i> tree.
5	17°40'17.33"N	99°52'10.09"W	Leonardo Bravo	2,400	SMS	OPF	Indirect ^d	-----	-----
6	17°40'04.70"N	99°56'37.50"W	Leonardo Bravo	1,384	SMS	C	Indirect ^c	-----	-----
7	17°33'56.55"N	99°23'13.91"W	Tixtla de Guerrero	1,344	BD	C	Direct ^a	-----	During hurricanes Ingrid and Manuel, the porcupine seek shelter in a villagers' house; it was released afterward.
8	17°33'27.64"N	99°23'00.37"W	Tixtla de Guerrero	1,362	SMS	LDTF	Indirect ^c	-----	-----
9	17°33'58.20"N	99°34'03.96"W	Chilpancingo de los Bravo	1,525	SMS	C	Direct ^a	-----	Climbing a shrub; it possibly used it as shelter upon feeling threatened by the presence of people.
10	17°31'46.25"N	99°27'48.84"W	Chilpancingo de los Bravo	1,497	BD	OF	Indirect ^c	-----	-----
11	17°29'16.26"N	99°27'14.92"W	Chilpancingo de los Bravo	1,177	BD	LDTF	Direct ^a	13:00	On a tree of the genus <i>Pithecellobium</i> ; the porcupine was attacked by children from the community.
12	17°29'07.98"N	99°27'56.25"W	Chilpancingo de los Bravo	1,151	BD	C	Indirect ^b	-----	Porcupine attacked by dogs; it died from the severity of the injuries.
13	17°29'01.53"N	99°25'23.58"W	Chilpancingo de los Bravo	1,050	SMS	LDTF	Indirect ^d	-----	Local inhabitants comment that porcupines are misidentified for tlacuaches by their naked tail.
14	17°28'37.40"N	99°26'26.30"W	Chilpancingo de los Bravo	1,365	SMS	LDTF	Indirect ^c	-----	-----
15	17°31'30.36"N	100°40'27.48"W	Técpán de Galeana	849	SMS	OF	Direct ^a	22:00	Inside the forest, two individuals were observed on the canopy.
16	17°30'29.00"N	100°41'46.00"W	Técpán de Galeana	681	SMS	OPF	Direct ^a	20:30	Inside the forest, an individual was observed sniffing the soil.
17	17°30'17.64"N	100°42'32.16"W	Técpán de Galeana	736	SMS	OPF	Direct ^a	22:00	Two organisms were observed on the canopy.
18	17°28'33.33"N	100°45'44.78"W	Técpán de Galeana	1,270	SMS	MCF	Direct ^a	-----	An individual was observed in a mountain cloud forest.
19	17°28'30.00"N	100°45'04.45"W	Técpán de Galeana	1,336	SMS	MCF	Direct ^a	-----	On a <i>Cecropia obtusifolia</i> tree.
20	17°26'53.24"N	100°13'01.34"W	Atoyac de Álvarez	1,443	SMS	MCF	Direct ^a	21:00	On a <i>Ficus</i> tree.
21	17°25'27.36"N	100°10'55.62"W	Atoyac de Álvarez	1,670	SMS	MCF	Direct ^a	08:00	On an <i>Inga vera</i> tree.
22	17°21'37.14"N	99°28'03.22"W	Chilpancingo de los Bravo	829	SMS	C	Indirect ^d	-----	-----
23	17°21'09.48"N	99°27'03.11"W	Mochitlán	745	SMS	OF	Direct ^a	20:00	Climbing a large (unidentified) tree in a ravine.
24	17°19'33.55"N	99°34'12.98"W	Chilpancingo de los Bravo	651	SMS	PF	Direct ^a	22:40	Feeding on a <i>Mangifera</i> tree.
25	17°16'54.93"N	99°28'30.08"W	Chilpancingo de los Bravo	927	SMS	OPF	Direct ^a	20:30	Climbing a rock wall covered by <i>Ficus petiolaris</i> roots.
26	17°13'24.14"N	98°38'01.68"W	Malinaltepec	2,216	SMS	OPF	Direct ^a	-----	Individual captured in a sawmill, then released into natural vegetation near the locality.
27	17°17'42.34"N	100°13'27.40"W	Atoyac de Álvarez	1,178	SMS	MCF	Indirect ^c	-----	-----
28	17°16'15.75"N	99°57'41.74"W	Chilpancingo de los Bravo	1,070	SMS	OPF	Indirect ^c	-----	-----
29	17°15'06.63"N	100°19'28.13"W	Atoyac de Álvarez	742	SPCPH	OPF	Direct ^a	10:00	On the branches of an unidentified tree.

Table 1. Continuation...

No.	Latitude	Longitude	Municipality	Altitude (m)	Ecoregion	Vegetation	Record type	Activity (hr)	General observations
30	17°07'05.88"N	99°44'12.48"W	Acapulco de Juárez	643	SPCPH	PF	Direct ^a	-----	On a <i>Curatella americana</i> tree.
31	17°06'11.52"N	99°19'50.90"W	Juan R. Escudero	542	SMS	OF	Indirect ^c	-----	-----
32	17°04'26.21"N	99°41'39.76"W	Acapulco de Juárez	664	SPCPH	PF	Direct ^a	13:00	On an <i>Annona squamosa</i> tree.
33	17°04'22.51"N	99°41'35.68"W	Acapulco de Juárez	644	SPCPH	PF	Indirect ^b	-----	Porcupine sighted on the top of a tree and shot after being misidentified for a badger.
34	17°03'43.63"N	98°52'58.34"W	San Luis Acatlán	1,320	SMS	PF	Indirect ^b	-----	-----
35	17°02'46.72"N	99°19'36.60"W	Tecoanapa	739	SMS	LDTF	Direct ^a	13:00	Resting on an oak tree.
36	17°02'56.54"N	98°50'53.74"W	San Luis Acatlán	1,280	SMS	OPF	Indirect ^b	-----	-----
37	17°02'57.29"N	98°49'34.95"W	San Luis Acatlán	1,100	SMS	C	Indirect ^b	-----	-----
38	17°01'43.06"N	98°51'06.14"W	San Luis Acatlán	1,005	SMS	PF	Indirect ^b	-----	-----
39	17°00'47.32"N	98°40'13.44"W	Malinaltepec	971	SMS	OPF	Indirect ^c	-----	-----
40	17°00'10.14"N	100°11'43.93"W	Coyuca de Benítez	15	SPCPH	C	Indirect ^d	-----	-----
41	16°57'48.61"N	99°53'10.05"W	Acapulco de Juárez	225	SPCPH	LDTF	Direct ^a	-----	Porcupine climbing a <i>Gliricidia sepium</i> tree; the villagers saw dogs injured by porcupine spines.
42	16°54'09.00"N	99°56'21.65"W	Acapulco de Juárez	279	SPCPH	LDTF	Direct ^a	-----	Porcupine crossing a patch with scarce vegetation, heading into denser vegetation (LDTF).
43	16°53'32.21"N	99°53'49.33"W	Acapulco de Juárez	361	SPCPH	MSETF	Direct ^a	07:00	Porcupine sniffing the understory.
44	16°42'04.58"N	99°38'34.56"W	Acapulco de Juárez	7	SPCPH	C	Indirect ^b	-----	-----
45	16°39'06.97"N	98°52'42.34"W	Copala	80	SPCPH	LDTF	Direct ^a	18:40	Individual sheltered in a <i>Mangifera</i> tree.

lán et al. 2005; Espinosa-Martínez et al. 2017). Mammals have been studied in the State of Guerrero for almost 148 years (Espinosa-Martínez et al. 2017) and only 10 papers have been published that provide indirect information on *S. mexicanus*, which underlines the scarcity of information for some species (Leopold 1959; Lozano-Guzmán 1983; Sánchez-Hernández and Gaviño de la Torre 1988; León-Paniagua and Romo-Vázquez 1991; Jiménez-Almaraz et al. 1993; Almazán-Núñez et al. 2011; Marín et al. 2016; Almazán-Núñez et al. 2018; Zavala-Sánchez et al. 2018; Ruiz-Gutiérrez et al. 2020). This analysis gathers and expands for the first time the knowledge of the current distribution of *S. mexicanus* in the State of Guerrero.

Forty-six percent ($n = 21$) of our records add 11 municipalities to the distribution of *S. mexicanus*, where no previous records had been documented (Cocula, Copala, Coyuca de Benítez, La Unión, Malinaltepec, Mártir de Cuilapan, Mochitlán, San Luis Acatlán, Tecoanapa, Tépán de Galeana, and Tixtla de Guerrero). The updated database generated in this paper confirms the presence of the species in 19 municipalities in the State of Guerrero. In addition, the knowledge of the distribution of the species for the Balsas Depression is enriched with six additional records; to note, only a single record for this ecoregion had been reported 37 years ago, between the borders of Guerrero and Michoacán (Lozano-Guzmán 1983).

In the past 15 years, two proposals have been generated that predict the potential distribution of *S. mexicanus* in México and Central America (Ceballos et al. 2006; Lavar-

iega and Briones-Salas 2019); however, 27 % ($n = 12$) of the records reported here do not match the distribution projections referred, as they are outside the proposed areas. The spatial distribution of living organisms is known to be dynamic and experiences contractions and expansions over time (Maciel-Mata et al. 2015), so we can expect to find records outside the known or potential distribution of the species. It is necessary to incorporate all records from this study to improve predictive distribution models; also, more georeferenced records are needed to assess habitat suitability and frequency of records in different regions.

Recent studies describe the distribution of *S. mexicanus* at state and national levels (e.g., Monterrubio-Rico et al. 2010; Ramírez-Bravo 2012; Lira-Torres et al. 2014; Lorenzo et al. 2014; Cisneros-Palacios et al. 2015). However, there are still several states that lack an accurate diagnosis indicating the relationship between distribution and environmental parameters. The proportion of records of live organisms reported here ranges between 43 % and 72 %; this can be considered an indirect measure of the status of possibly stable populations. We recorded a total of nine genera of tree species (*Annona*, *Cecropia*, *Curatella*, *Enterolobium*, *Ficus*, *Gliricidia*, *Inga*, *Mangifera*, *Pithecellobium*) used by porcupines, which is consistent with the literature (Monterrubio-Rico et al. 2010; Lorenzo et al. 2014), except for the genera *Curatella* and *Gliricidia*, which had not been reported.

The records of direct observations of *S. mexicanus* in this work are located at an average distance of 37 km from records of observations reported historically (Figure 2),

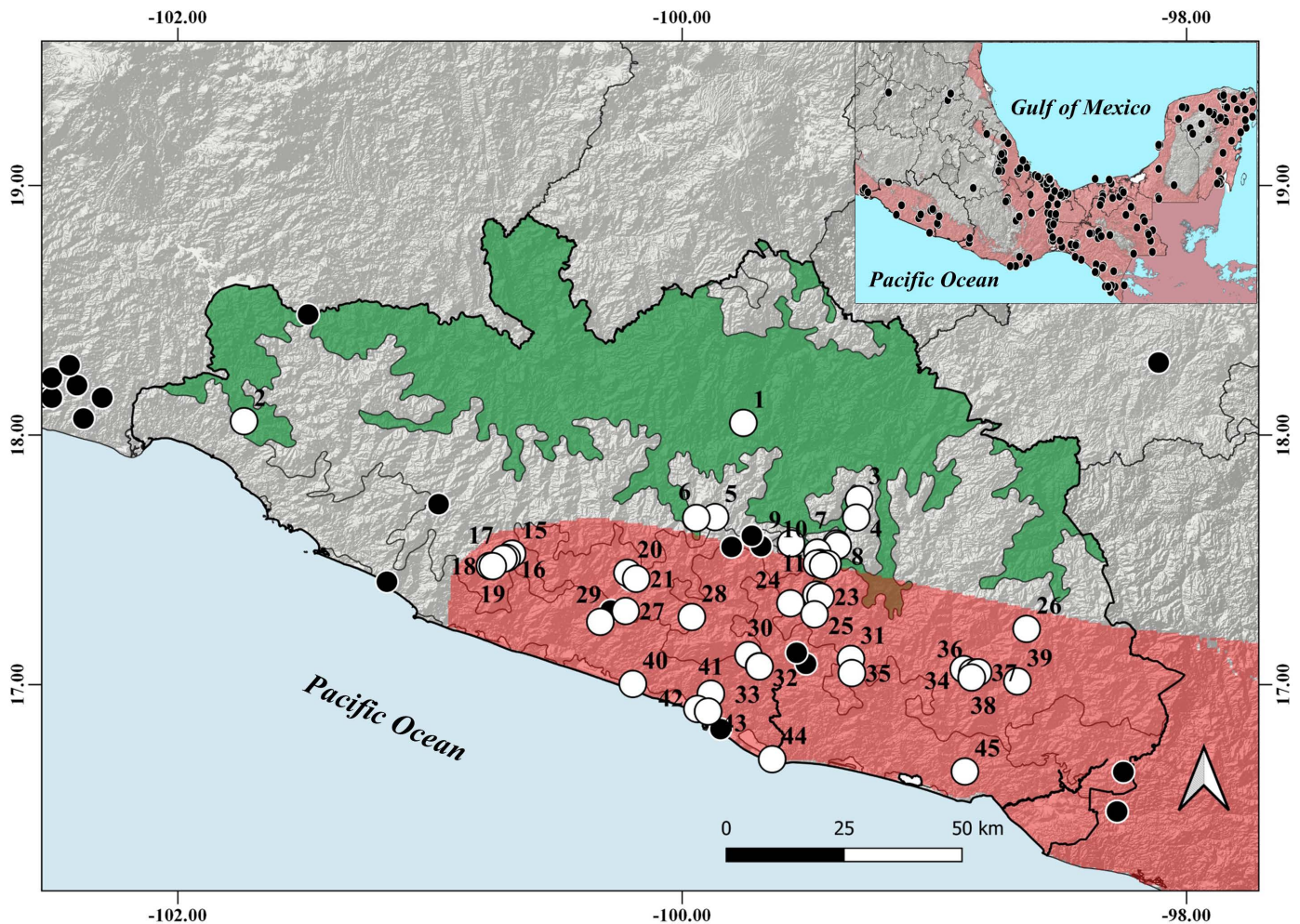


Figure 2. Map of the distribution of records of *Sphiggurus mexicanus* in Guerrero, México. The area marked in red is the potential distribution proposed by Ceballos *et al.* (2006) and Lavariaga and Briones-Salas (2019). The area marked in green corresponds to the Balsas Depression terrestrial ecoregion. White circles mark the records in this study; black circles are historical records from the scientific literature and electronic repositories.

indicating the expansion of the distribution of the species to the Balsas Depression terrestrial ecoregion in Guerrero. This information can be used in the development of new research aiming to provide information on its biology and ecology for management and conservation purposes. Our results show hunting and roadkills as causes of mortality of *S. mexicanus* in Guerrero; on 11 occasions, the records corresponded to affected individuals.

Sixty-seven percent ($n = 30$) of the records obtained are located in temperate forests ($n = 19$) and dry forests ($n = 11$). As *Sphiggurus mexicanus* is a species of arboreal habits (Juárez-G. 2005; Monterrubio-Rico *et al.* 2010), it depends on forests (Lorenzo *et al.* 2014), which is confirmed by most of our observations of porcupines performing activities on the canopy. The nine records located in crops support the assumption that porcupines can take advantage of crops when seeds, fruits, and buds are available, and these may be occasional records, as stated by Lorenzo *et al.* (2014).

This paper highlights the importance of continuing conducting scientific surveys in the state, particularly in areas that have been poorly explored. In addition, local commu-

nities should be encouraged to develop a responsible coexistence with nature, protecting forests through the certification by the National Commission on Natural Protected Areas (CONANP), which decrees Areas Purposely Dedicated to Conservation.

Acknowledgements

We thank all the people who provided assistance in data collection, especially the members of Bio-Explora Guerrero. The first author thanks E. A. Alvarez-Alvarez, P. Sierra-Morales, and M. Brito-Millan for their valuable comments that improved the manuscript. We also thank the reviewers for their comments and recommendations that helped improve this work. M. E. Sánchez-Salazar translated the manuscript into English.

Literature cited

ALMAZÁN-CATALÁN, J. A., C. SÁNCHEZ-HERNÁNDEZ, AND M. L. ROMERO-ALMARAZ. 2005. Registros sobresalientes de mamíferos del Estado de Guerrero, México. *Acta Zoológica Mexicana* 21:155-157.

- ALMAZÁN-NÚÑEZ, R. C., A. ALMAZÁN-JUÁREZ, AND F. RUIZ-GUTIÉRREZ.** 2011. Áreas comunitarias para la conservación de los recursos biológicos de la Sierra Madre del Sur, Guerrero, México. *Universidad y Ciencia* 27:315-329.
- ALMAZÁN-NÚÑEZ, R. C., E. A. ALVAREZ-ALVAREZ, F. RUIZ-GUTIÉRREZ, Á. ALMAZÁN-JUÁREZ, P. SIERRA-MORALES, AND S. TORIBIO-JIMÉNEZ.** 2018. Biological survey of a cloud forest in southwestern Mexico: plants, amphibians, reptiles, birds, and mammals. *Biota Neotropical* 18:e20170444.
- ARANDA, M.** 2012. Manual para el rastreo de mamíferos silvestres de México. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México City, México.
- BARRAGÁN, F., C. LORENZO, A. MORÓN, M. A. BRIONES-SALAS, AND S. LÓPEZ.** 2010. Bat and rodent diversity in a fragmented landscape on the Isthmus of Tehuantepec, Oaxaca, Mexico. *Tropical Conservation Science* 3:1-16.
- BRIONES-SALAS, M., AND V. SÁNCHEZ-CORDERO.** 2004. Mamíferos. Pp. 423-447 in *Biodiversidad de Oaxaca* (García-Mendoza, A. J., M. J. Ordoñez, and M. Briones-Salas, eds.). Instituto de Biología, UNAM-Fondo Oaxaqueño para la Conservación de la Naturaleza-World Wildlife Fund. México City, México.
- CEBALLOS, G., S. BLANCO, C. GONZÁLEZ, AND E. MARTÍNEZ.** 2006. *Coendu mexicanus* (Puercoespín). Distribución potencial. Extraído del proyecto DS006 "Modelado de la distribución de las especies de mamíferos de México para un análisis GAP". Con un tamaño de píxel: 0.01 grados decimales. Instituto de Biología, Universidad Nacional Autónoma de México (UNAM), Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO). México City, México.
- CISNEROS-PALACIOS, M. E., G. REYES-MACEDO, A. MÉNDEZ, G. MONROY, AND C. R. CALDERÓN.** 2015. Registros Notables del puerco espín tropical *Sphiggurus mexicanus* (Erethizontidae) en el estado de Oaxaca, México. *Therya* 6:647-652.
- CONABIO (COMISIÓN NACIONAL PARA EL CONOCIMIENTO Y USO DE LA BIODIVERSIDAD).** 2019. Ciclovida: Puercoespín (*Coendu mexicanus*). Publicación electrónica. Available in <http://enciclopedia.mx/especies/34303-coendu-mexicanus>. Downloaded on December 20, 2019.
- ESPINOSA-MARTÍNEZ, D. V., C. A. RÍOS-MUÑOZ, H. ROSALES NANDUCA, J. ARROYO-CABRALES, AND L. LEÓN-PANIAGUA.** 2017. Mamíferos de Guerrero. *Revista Mexicana de Mastozoología Nueva Época* 7:38-67.
- FALLER-MENÉNDEZ, J. C., T. URQUIZA-HAAS., C. CHÁVEZ., S. JOHNSON, AND G. CEBALLOS.** 2005. Registros de mamíferos en la reserva privada El Zapotal, en el Noreste de La Península de Yucatán. *Revista Mexicana de Mastozoología* 9:128-140.
- GBIF (THE GLOBAL BIODIVERSITY INFORMATION FACILITY).** 2019. GBIF.org Available in <https://doi.org/10.15468/dl.ec6sfy>.
- GALINDO-AGUILAR, R. E., AND M. C. LAVARIEGA.** 2019. Registros recientes de *Caluromys derbianus* (Didelphimorphia: Didelphidae), *Tamandua mexicana* (Pilosa: Myrmecophagidae) y *Coendu mexicanus* (Rodentia: Erethizontidae) en Oaxaca, México. *Notas Mastozoológicas Sociedad Colombiana de Mastozoología* 5:20-24.
- HALL, E. R.** 1981. *The Mammals of North America*. John Wiley and Sons. New York, U.S.A.
- INEGI (INSTITUTO NACIONAL DE ESTADÍSTICA, GEOGRAFÍA E INFORMÁTICA), CONABIO (COMISIÓN NACIONAL PARA EL CONOCIMIENTO Y USO DE LA BIODIVERSIDAD), AND INE (INSTITUTO NACIONAL DE ECOLOGÍA).** 2008. Ecorregiones terrestres de México. Escala 1:1,000,000. México City. Available at http://www.conabio.gob.mx/informacion/metadatos/gis/ecort08gw.xml?_xsl=/db/metadatos/xsl/fgdc.html.xsl&_indent=no. Downloaded on March 11, 2021.
- INEGI (INSTITUTO NACIONAL DE ESTADÍSTICA, GEOGRAFÍA E INFORMÁTICA).** 2010. Conjunto de datos vectoriales de la carta de uso del suelo y vegetación: escala 1:250 000. Serie IV (continuo nacional). Instituto Nacional de Estadística y Geografía. Aguascalientes, México. Available at <https://www.inegi.org.mx/temas/usuarios/#Mapa>. Downloaded on March 11, 2021.
- JIMÉNEZ-ALMARAZ, T., J. JUÁREZ GÓMEZ, AND L. LEÓN PANIAGUA.** 1993. Mamíferos. Pp. 503-549 in *Historia natural del parque ecológico Omiltemi, Chilpancingo, Guerrero, México* (Luna Vega, I., and J. Llorente Bousquet, eds.). Consejo Nacional para el Conocimiento y Uso de la Biodiversidad and Universidad Nacional Autónoma de México. México City, México.
- JUÁREZ-G., J. R.** 2005. *Coendu mexicanus* (Kerr, 1792). Pp. 811-812 in *Los Mamíferos silvestres de México* (Ceballos G., and G. Oliva, eds.). Fondo de Cultura Económica, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México City, México.
- LAVARIEGA, M. C., AND M. BRIONES-SALAS.** 2019. *Coendu mexicanus* (puercoespín). Distribución potencial, escala 1:000000. Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional Unidad Oaxaca, Xoxocotlán, Oaxaca, México. Available at http://www.conabio.gob.mx/informacion/gis/?vns=gis_root/biodiv/distpot/dpmamif/dpmrodent/cme011dpgw. Downloaded on March 11, 2021.
- LEÓN-PANIAGUA, L., AND E. ROMO-VÁZQUEZ.** 1991. Catálogo de mamíferos (Vertebrata: Mammalia). Serie Catálogos del Museo de Zoología "Alfonso L. Herrera". Facultad de Ciencias, Universidad Nacional Autónoma de México 2:1-68.
- LEOPOLD, A. S.** 1959. *Wildlife of Mexico: The Game Birds and Mammals*. University of California Press. California, U.S.A.
- LIRA-TORRES, I. G.** 2006. Abundancia, densidad, preferencia de hábitat y uso local de los vertebrados en La Tuza de Monroy, Santiago Jamiltepec, Oaxaca. *Revista Mexicana de Mastozoología* 10:41-66.
- LIRA-TORRES, I. G., L. M. AMBRIZ, M. A. C. ESCOBAR, AND R. E. G. AGUILAR.** 2005. Mastofauna del Cerro de la Tuza, Oaxaca. *Revista Mexicana de Mastozoología* 9:6-20.
- LIRA-TORRES, I., G. SÁNCHEZ-ROJAS, D. OJEDA-RAMÍREZ, AND F. R. GÓMEZ DE ANDA.** 2014. Registro Notable del Puercoespín Arborescente *Sphiggurus mexicanus* (Rodentia: Erethizontidae) en la Sierra Madre Oriental, México. *Therya* 5:271-275.
- LORENZO, C., E. C. SÁNTIZ, D. A. NAVARRETE, AND J. BOLAÑOS.** 2014. Causes and consequences of change rates in the habitat of the threatened tropical porcupine, *Sphiggurus mexicanus* (Rodentia: Erethizontidae) in Oaxaca, Mexico: implications for its conservation. *Revista de Biología Tropical* 62:1481-1494.
- LOZANO-GUZMÁN, F.** 1983. Estudios preliminares a cerca de la fauna del estado de Guerrero (Vertebrados Terrestres). Universidad Autónoma de Guerrero, Dirección de Publicaciones, México, Serie Técnico Científica.
- MACIEL-MATA, C. A., N. MANRÍQUEZ-MORÁN, P. OCTAVIO-AGUILAR, AND G. SÁNCHEZ-ROJAS.** 2015. El área de distribución de las especies: revisión del concepto. *Acta Universitaria* 25:59-69.
- MARÍN, A., G. CEBALLOS, AND J. PACHECO.** 2016. Mamíferos en dos localidades de selva seca en el estado de Guerrero. *Revista Mexicana de Mastozoología Nueva Época* 6:50-67.

- MEJENES-LÓPEZ, S. M. A., M. HERNÁNDEZ-BAUTISTA, J. BARRAGÁN-TORRES, AND J. P. RODRÍGUEZ.** 2010. Los mamíferos en el Estado de Hidalgo, México. *Therya* 1:161-188.
- MONTECUBIO-RICO, T. C., J. M. ORTEGA-RODRÍGUEZ, N. MENDOZA-CÁRDENAS, R. CANCINO-MURILLO, AND A. PÉREZ-ARTEAGA.** 2010. Distributional and Ecological Records of the Mexican Hairy Dwarf Porcupine (*Sphiggurus mexicanus*) from Michoacán, Mexico. *The Southwestern Naturalist* 55:139-142.
- NATURALISTA.** 2019. Available at <https://www.naturalista.mx>. Downloaded on December 1, 2019.
- RAMÍREZ-BRAVO, O. E.** 2012. New records of the Mexican hairy porcupine (*Coendou mexicanus*) and tamandua (*Tamandua mexicana*) in Puebla, central Mexico. *Western North American Naturalist* 72:93-95.
- RIECHERS-PÉREZ, A.** 2004. Análisis mastofaunístico de la Zona Sujeta a Conservación Ecológica Laguna Bélgica, Chiapas, México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 75:363-382.
- RUIZ-GUTIÉRREZ, F., C. CHÁVEZ, G. SÁNCHEZ-ROJAS, C. E. MORENO, C. GONZÁLEZ-SALAZAR, B. O. RUIZ-GUTIÉRREZ, AND R. TORRES-BERNAL.** 2020. Mamíferos medianos y grandes de la Sierra Madre del Sur de Guerrero, México: evaluación integral de la diversidad y relación con las características ambientales. *Revista Mexicana de Biodiversidad* 91:e913168.
- SÁNCHEZ-HERNÁNDEZ, C, AND G. GAVIÑO DE LA TORRE.** 1988. Registro de tres especies de mamíferos para la región central de México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 58:477-478.
- SEMARNAT (SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES).** 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario oficial de la Federación (segunda sección) del 30 de diciembre de 2010.
- VÁZQUEZ, E., F. REID, AND A. D. CUARÓN.** 2016. *Coendou mexicanus*. The IUCN Red List of Threatened Species 2016: e.T20629A22214103. <https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T20629A22214103.en>. Downloaded on December 22, 2019.
- WAINWRIGHT, M.** 2002. The natural history of Costa Rican mammals. Zona Tropical, San José, Costa Rica.
- ZAVALA-SÁNCHEZ, Z., H. R. SEGURA-PACHECO, D. M. ÁVILA-NAJERA, N. D. HERRERA-CASTRO, E. BARRERA-CATALÁN, AND G. SARABIA-RUIZ.** 2018. Valoración cultural y uso de la fauna silvestre en San Vicente de Benítez, Guerrero, México. *Revista Etnobiología* 16:78-92.

Associated editor: Romeo A. Saldaña-Vázquez

Submitted: February 17, 2020; Reviewed: February 13, 2021.

Accepted: May 2, 2021; Published on line: May 31, 2021.