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Mammals from Los Mármoles National Park, one of the first protected areas in Mexico

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Los Mármoles National Park (state of Hidalgo) is one of the oldest protected natural areas in Mexico. Due to its geographical location, it contains both Nearctic and Neotropical species, although the mammal species inhabiting the area have been poorly studied. This information is required to establish conservation actions in the area, which is heavily affected by mining and illegal logging. We sampled mammals across nine non-consecutive years (2013-2018, 2021-2022, and 2025) and searched records in literature to produce the first updated checklist for Los Mármoles. We conducted 62 field trips of varying lengths (1 to 12 days). We used pitfall and Sherman traps, mist nets, camera traps, and scent stations to trap mammals. In addition, we conducted interviews with local people and obtained incidental records (*e.g.*, observations, dead animals, tracks, excrement). We recorded 85 native mammal species, including 10 protected species and 15 endemic species to Mexico. Chiroptera, Carnivora, and Rodentia were the most well-represented groups with the highest number of species in this study, highlighting the presence of large carnivores, such as *Ursus americanus* and *Panthera onca*. We documented domestic and feral animals within the protected area. Although Los Mármoles is home to more than 50% of the state's mammal species, it faces serious threats, such as mining, feral dogs, and livestock.

Keywords. Carnivora, Chiroptera, feral animals, protected areas, Rodentia, temperate forest, trap-cameras.

El Parque Nacional Los Mármoles (estado de Hidalgo) es una de las áreas naturales protegidas más antiguas en México. Debido a su ubicación geográfica, contiene especies tanto Neárticas como Neotropicales, aunque las especies de mamíferos que habitan el área han sido poco estudiadas. Esta información es necesaria para establecer acciones de conservación en el área, la cual es fuertemente impactada por la minería y la tala ilegal. Se conjuntó la información del muestreo de mamíferos durante nueve años no consecutivos (2013-2018, 2021-2022 y 2025) y de la literatura para generar el primer listado actualizado para el parque. Realizamos 62 salidas de campo con duración variable (1 a 12 días). Los mamíferos se capturaron con trampas de caída y Sherman, redes de niebla, cámaras trampa y estaciones olfativas. Además, se realizaron entrevistas entre la gente local y se usaron registros incidentales (*p.ej.*, observaciones, animales muertos, huellas, excretas). Se registraron 85 especies de mamíferos nativos, incluyendo 10 especies protegidas y 15 especies endémicas de México. Chiroptera, Carnivora y Rodentia fueron los grupos con mayor número de especies en este estudio, donde destacan la presencia de grandes carnívoros, como *Ursus americanus* y *Panthera onca*, así como la presencia de mamíferos domésticos y ferales dentro del bosque del área protegida. A pesar de que Los Mármoles alberga más del 50% de las especies de mamíferos del estado, enfrentan graves amenazas como la minería, los perros ferales y el ganado.

Palabras clave: Animales ferales, áreas protegidas, bosque templado, cámaras trampa, Carnivora, Chiroptera, Rodentia.

Protected Areas (PAs) are an "area-based conservation tool" implemented globally, to counteract the loss of biodiversity by various anthropogenic factors, such as overexploitation of natural resources, population growth, deforestation, and illegal traffic (Gurney *et al.* 2023), with protected areas covering about 15% of land surface and 7.4% of ocean surface (UNEP-WCMC and IUCN 2021). Mexico possesses 232 PAs, extending 98,000,719 ha (*ca*. 35.54% of the territory; CONANP 2025). Of them, 79 (22.12%) are National Parks (NPs; CONANP 2025), defined as "large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities" (*sensu* Dudley 2008, see also LGEEPA 2024), and are primarily characterized by the beauty of their

landscapes (Villalobos 2000). Many of these areas are insufficient to protect some highly diverse groups of flora and fauna (Falcón-Brindis *et al.* 2021; Chávez-Lugo *et al.* 2024), making the continuous actualization of species lists within protected areas fundamental for making appropriate management and conservation decisions.

Hidalgo is a state in central Mexico, known for its mountainous terrain, which lies in a transitional zone between Neartic and Neotropical biogeographic regions (Escalante *et al.* 2004), and located in the Sierra Madre Oriental and the Veracruzan biogeographic province (Morrone *et al.* 2017; Morrone 2019). In Hidalgo, five PAs are federally constituted, covering about 6% of the territory and 131,742 hectares (CONANP 2025). "Los Mármoles National Park" (hereafter, Los Mármoles) was decreed on September 8th, 1936, with a total area of 23,150 ha, being the second federally protected area in the state. Los Mármoles derives its name from the marble deposits found throughout the region (CONANP 2024). Despite being almost 90 years old, it was formally administered by the federal government just in 2010 (M. A. Soto-Martínez personal communication, former director of Los Mármoles), which led to different environmental and political problems, with mining (marble exploitation) and illegal logging being the human activities with the most significant impact (Arroyo-Ruiz and Cuevas-Cardona 2017), which contradicts the current legislations that states "Only activities related to the protection of natural resources, the enhancement of flora and fauna…the preservation of ecosystems and their elements, as well as ecological research, recreation, tourism, and education, may be permitted in national parks" (article 50°, LGEEPA 2024). However, due to its rugged topography, there are areas of difficult access that have allowed the maintenance of well-conserved areas and the conservation of part of its native biodiversity.

Over the last two decades, inventories and systematic revisions have been carried out to finally have a baseline on the biodiversity that Los Mármoles harbors, covering various groups of flora (Ramírez-Cruz *et al.* 2009; Álvarez-Zúñiga *et al.* 2010; Sánchez-González *et al.* 2010; Delgadillo-Moya *et al.* 2011; García-Sánchez *et al.* 2014), invertebrates (Asiain *et al.* 2011), and vertebrates (Aguilar-López *et al.* 2015a, 2015b; Larios-Lozano *et al.* 2017; Aguilar-López *et al.* 2019; Flores-Hernández 2019; CONANP 2020). Mammals play several ecosystem roles, such as pollinators and seed dispersers, predators of various arthropods, and prey of other animals, including humans (Zalapa *et al.* 2005; Bagchi *et al.* 2006; Kunz *et al.* 2011), thus directly influencing human well-being. Despite their ecological importance, mammalian biodiversity in Los Mármoles is poorly known (Mendoza-Vega 2012; CONANP 2024). This information gap influences the proposal and implementation of conservation strategies at the park, in addition to the fact that, in recent years, there has been an insistence on the re-categorization of the area to allow extractive activities (Arroyo-Ruiz and Cuevas-Cardona 2017), which makes it essential to have all the information on the biological diversity of the area for decision-making and appropriate management.

Therefore, our objective was to compile the information generated over nine years of research on mammals conducted with the participation of community brigades in the park, complemented it with data from scientific literature and interviews with local community members, to provide an updated list of the resident mammal species of Los Mármoles, as a basis for revising the management plan.

Materials and methods

Los Mármoles covers an area of 23,150 ha (1.1% of the state area), located northeast of the state of Hidalgo, Mexico (20°45'33" and 20°58'47" N; 99°08'55" and 99°18'37" W), covering the municipalities of Zimapán, Nicolás Flores, Jacala de Ledezma, and Pacula (CONANP 2024). Los Mármoles is part of the Sierra Gorda (located mainly in Guanajuato, but some parts are included in the states of San Luis Potosí, Guanajuato, and Hidalgo), within the Sierra Madre Oriental (Randell-Badillo 2008). Elevation ranges from 1,000 m to 3,000 m, and the vegetation is predominantly temperate affinity composed mainly of *Quercus*, *Pinus*, *Juniperus,* and *Cupressus* forests, covering most of the area in Los Mármoles, while other vegetation types are less dominant, such as spiny shrubland and deciduous lowland forest (CONANP 2007; Ramírez-Cruz *et al.* 2009). The climate is temperate sub-humid with summer rains (covering 20,008 ha) and semi-warm sub-humid with summer rains (3,142 ha; 450 to 1,500 mm; SARH 1994; CONANP 2007).

For the recording of mammals, we conducted 62 field trips (22 for bat sampling exclusively and two trips for other small mammals), ranging from one to 12 days. We visited 48 localities in four municipalities within and adjacent to Los Mármoles from 2013-2018, 2021-2022, and 2025 (carried out by the community brigade "El Cobre"), covering most of the area and all the vegetation types and heights in the park (Figure 1). Accordingly, field trips were conducted by different people over the years and framed in independent projects with various objectives, therefore, sampling varied among years.

Small mammals (bats, shrews, and mice). For recording bats, we conducted interviews to locate potential roosting sites in 43 localities, within and outside the area of Los Mármoles. These interviews were conducted in 2015 and 2017. At each site, we first contacted a representative from a given community and local officials to reach people who, due to their work, knew the area and may recognize local fauna, such as livestock farmers, agricultural workers, and community brigade members (enrolled in firefighting activities or those responsible for communal lands or resources). Subsequently, we employed the "snowball" sampling technique, in which each interviewee provides contact information about other people who could

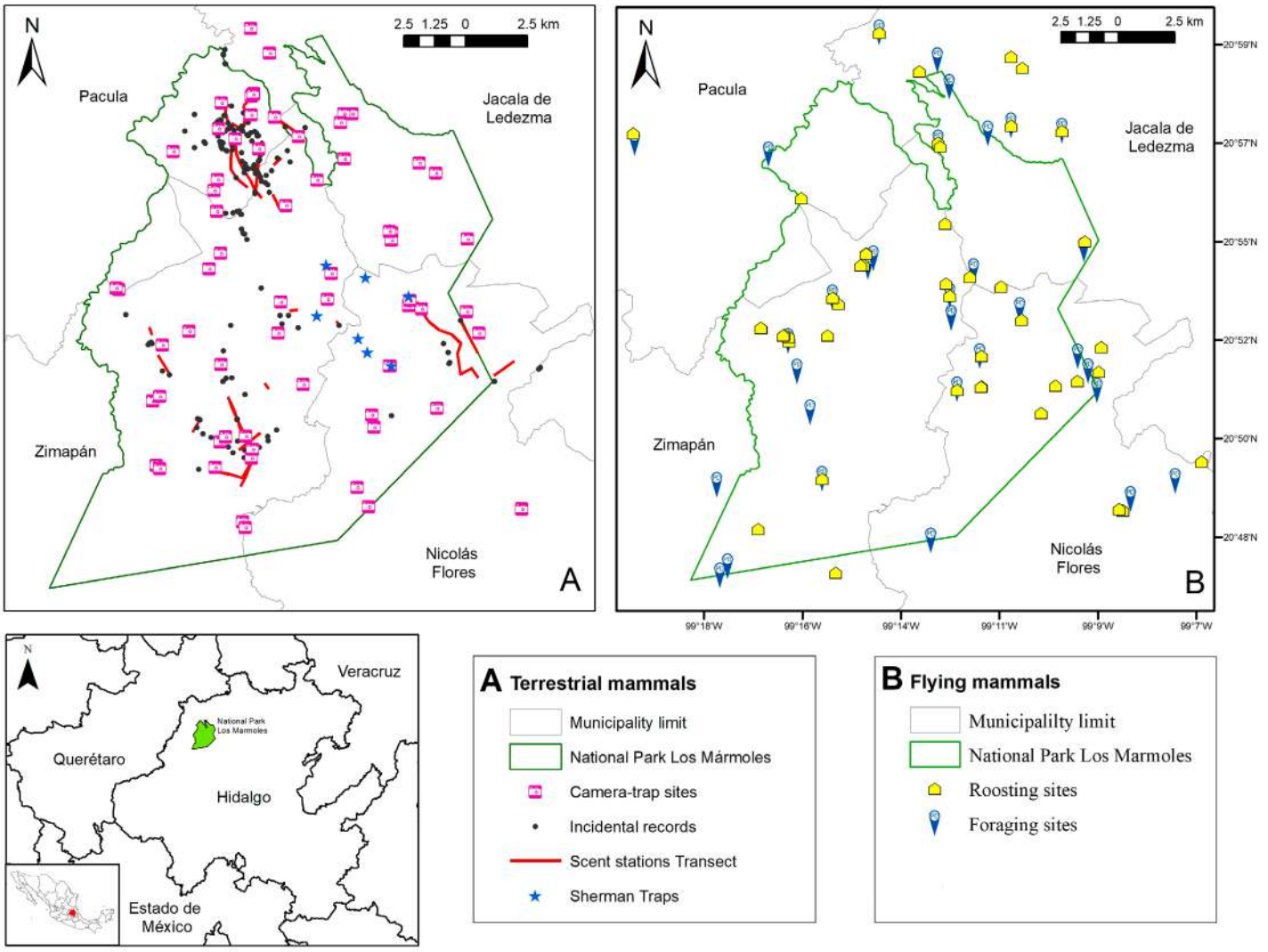

Figure 1. Location of Los Mármoles National Park and sampling sites for this study. A. Location of camera traps and scent stations, and incidental records of terrestrial mammals. B. Mist-netting sites at roosts and in fly corridors in probable roosting foraging areas of bats.

be interviewed (Castillo-Álvarez and Peña-Mondragón 2015). Specifically for bats, we applied semi-structured interviews, each consisting of a total of 14 questions (Supplementary Data 1).

We sampled bats using up to six (minimum of one) mist-nets per night (3, 6, 10, and 12 m long) per site/night (one to three nights per site) in potential flight paths for bats (vegetation boundaries, rural paths, natural ponds, ravines, and similar locations; (Kunz *et al.* 2009; Bracamonte 2018), as well as at the entrance of roosting sites (caves, mines, hollow trees, rooftops). Nets were functional from before astronomical twilight (around 17:00-18:00 hrs. depending on the season) until midnight (seven hours per night). Potential roosting sites were visited during the day to determine if it was a diurnal or a nocturnal (*i.e.*, only used during the night) roost. For species identification, we used morphological criteria (*i.e.,* relative size, forearm, foot, and ear lengths, fur and coloration patterns) and field guides (Hall 1981; Aranda 2000, 2012; Medellín *et al.* 2008; Álvarez-Castañeda *et al.* 2015). For each captured individual, we recorded the following data: date of record, locality, type of vegetation, sex (male or female), age category (juvenile, subadult, adult by the ossification of finer epiphyseal joints, tooth wear, fur coloration), weight (g), reproductive condition (through the visual inspection of the testes and epididymal position in males, and the distension of lower abdomen, palpation of the abdomen and inspection of the nipples in females), and other somatic measurements (Hall 1981; Brunet-Rossinni and Wilkinson 2009). Captured individuals were handled and released following the suggestions of Kunz *et al.* (2009). Most of the individuals were released at the capture site, with one voucher specimen per species (except species protected by law).

For rodents and shrews, we used 50 pitfall and 160 Sherman traps, which were placed around the bases of trees and along fallen trunks (Lorenzo *et al.* 2019). Sherman traps were baited with a mixture of oatmeal, peanut butter, and vanilla. No bait was used for pitfall traps. We conducted trapping at two locations in the spring of 2019 and the summer of 2022. Due to the region's limited knowledge of small mammals and difficulty identifying some taxa, we

Table 1. Mammalian species registered in this study (by method) and reported in databases/grey literature for the National Park Los Mármoles. The black point (•) indicates species of which a voucher specimen was collected, and the asterisk (*) indicates protected species. Biogeographic realm and endemicity follow the Mammal Diversity Database (2026) (NA= Neartic, NT= Neotropic).

	Order	Family	Species	Biogeographic realm/Endemism	Registered in this study[a]	Databases/ Literature[b]
1	Artiodactyla	Cervidae	*Odocoileus virginianus* (E. A. W. von Zimmermann, 1780)	NA/NT	IR, SS, CT	TH, CTCB[e]
2	Artiodactyla	Cervidae	*Mazama temama* (Kerr 1792)	NA/NT	CTCB	
3	Artiodactyla	Tayassuidae	*Dicotyles tajacu* (Linnaeus, 1758)	NT	IR, SS, CT	TH, CTCB[e]
4	Carnivora	Ursidae	*Ursus americanus** Pallas, 1780	NA	IN, CT	PA[d]
5	Carnivora	Felidae	*Herpailurus yagouaroundi** (É. Geoffroy Saint-Hilaire, 1803)	NA/NT	IN	CTCB[e]
6	Carnivora	Felidae	*Leopardus pardalis** (Linnaeus, 1758)	NT	IN, CT	DB, TH
7	Carnivora	Felidae	*Leopardus wiedii** (H. R. Schinz, 1821)	NT	IR, SS, IN, CT	DB, TH
8	Carnivora	Felidae	*Lynx rufus* (von Schreber, 1777)	NA	IR, SS, IN, CT	TH
9	Carnivora	Felidae	*Panthera onca** (Linnaeus, 1758)	NA/NT	IR, IN, CT	CTCB[e]
10	Carnivora	Felidae	*Puma concolor* (Linnaeus, 1771)	NA/NT	IR, SS, IN, CT	DB, TH
11	Carnivora	Canidae	*Canis latrans* Say in James, 1823	NA/NT	IR, SS, IN, CT	TH, CTCB[e]
12	Carnivora	Canidae	*Urocyon cinereoargenteus* (von Schreber, 1775)	NA/NT	IR, SS, IN, CT	TH, CTCB[e]
13	Carnivora	Mephitidae	*Conepatus leuconotus* (H. Lichtenstein, 1832)	NA/NT	IR, IN, CT	TH, CTCB[e]
14	Carnivora	Mephitidae	*Mephitis macroura* H. Lichtenstein, 1832	NA/NT	IR, IN, CT	DB, TH
15	Carnivora	Mephitidae	*Spilogale angustifrons* A. H. Howell, 1902	NA/NT	IN, CT	
16	Carnivora	Mustelidae	*Eira barbara** (Linnaeus, 1758)	NA/NT	IN, CT	
17	Carnivora	Mustelidae	*Neogale frenata* (H. Lichtenstein, 1831)	NA/NT	IR, IN, TC	TH
18	Carnivora	Procyonidae	*Bassariscus astutus* (H. Lichtenstein, 1830)	NA	IR, SS, IN, CT	DB, TH
19	Carnivora	Procyonidae	*Nasua narica* (Linnaeus, 1766)	NA/NT	SS, IN, CT	TH
20	Carnivora	Procyonidae	*Procyon lotor* (Linnaeus, 1758)	NA/NT	IR, SS, IN, CT	TH
21	Chiroptera	Mormoopidae	*Pteronotus mesoamericanus* J. D. Smith, 1972	NA/NT	MN	TH
22	Chiroptera	Mormoopidae	*Mormoops megalophylla*• W. C. H. Peters, 1865	NA/NT	MN	
23	Chiroptera	Molossidae	*Tadarida brasiliensis* (I. Geoffroy Saint-Hilaire, 1824)	NA/NT	MN	
24	Chiroptera	Natalidae	*Natalus mexicanus*• G. S. Miller, 1902	NA/NT	IR	
25	Chiroptera	Phyllostomidae	*Desmodus rotundus*• (*É*. Geoffroy Saint-Hilaire, 1810)	NA/NT	MN	TH
26	Chiroptera	Phyllostomidae	*Diphylla ecaudata*• von Spix, 1823	NA/NT	MN	
27	Chiroptera	Phyllostomidae	*Choeronycteris mexicana** von Tschudi, 1844	NA/NT	MN	TH
28	Chiroptera	Phyllostomidae	*Glossophaga mutica*• A. H. Merriam, 1898	NA/NT	MN	TH
29	Chiroptera	Phyllostomidae	*Micronycteris microtis*• G. S. Miller, 1898	NA/NT	MN	DB, TH
30	Chiroptera	Phyllostomidae	*Leptonycteris nivalis** (de Saussure, 1860)	NA	MN	TH
31	Chiroptera	Phyllostomidae	*Leptonycteris yerbabuenae* L. Martínez & Villa-Ramírez, 1940	NA/NT	MN	TH
32	Chiroptera	Phyllostomidae	*Anoura peruana* (von Tschudi, 1844)	NA/NT	MN	
33	Chiroptera	Phyllostomidae	*Artibeus intermedius* J. A. Allen, 1897	NA/NT	MN	
34	Chiroptera	Phyllostomidae	*Artibeus jamaicensis* Leach, 1821	NA/NT	MN	DB, TH
35	Chiroptera	Phyllostomidae	*Artibeus lituratus* (I. von Olfers, 1818)	NA/NT	MN	TH
36	Chiroptera	Phyllostomidae	*Dermanura azteca*• (Andersen, 1906)	NA/NT	MN	DB, TH
37	Chiroptera	Phyllostomidae	*Dermanura tolteca*• (de Saussure, 1860)	NA/NT	MN	TH
38	Chiroptera	Phyllostomidae	*Sturnira hondurensis*• G. G. Goodwin, 1940	NA/NT	MN	TH
39	Chiroptera	Phyllostomidae	*Sturnira parvidens*• E. A. Goldman, 1917	NA/NT	MN	TH
40	Chiroptera	Vespertilionidae	*Antrozous pallidus* (Le Conte, 1856)	NA/NT	MN	
41	Chiroptera	Vespertilionidae	*Corynorhinus mexicanus*• G. M. Allen, 1916	NA/Endemic	MN	DB, TH
42	Chiroptera	Vespertilionidae	*Corynorhinus townsendii*• (G. M. Allen, 1916)	NA	MN	
43	Chiroptera	Vespertilionidae	*Idionycteris phyllotis*• (G. M. Allen, 1916)	NA	MN	
44	Chiroptera	Vespertilionidae	*Eptesicus fuscus*• (Palisot de Beauvois, 1796)	NA/NT	MN	DB, TH
45	Chiroptera	Vespertilionidae	*Lasiurus frantzii*• (W. C. H. Peters, 1871)	NA/NT	MN	DB, TH
46	Chiroptera	Vespertilionidae	*Lasiurus cinereus* (Palisot de Beauvois, 1796)	NA/NT	MN	DB, TH

47	Chiroptera	Vespertilionidae	*Lasiurus intermedius*• H. Allen, 1862	NA/NT	MN	
48	Chiroptera	Vespertilionidae	*Myotis thysanodes* G. S. Miller, 1897	NA	MN	
49	Chiroptera	Vespertilionidae	*Myotis auriculus*• R. H. Baker & Stains, 1955	NA	MN	TH
50	Chiroptera	Vespertilionidae	*Myotis californicus*• (Audubon & Bachman, 1842)	NA	MN	TH
51	Chiroptera	Vespertilionidae	*Myotis ciliolabrum*• H. Merriam, 1886)	NA	MN	
52	Chiroptera	Vespertilionidae	*Myotis volans*• (H. Allen, 1866)	NA	MN	
53	Chiroptera	Vespertilionidae	*Myotis velifer*• (J. A. Allen, 1890)	NA/NT	MN	
54	Chiroptera	Vespertilionidae	*Myotis yumanensis*• (H. Allen, 1864)	NA	MN	
55	Chiroptera	Vespertilionidae	*Parastrellus hesperus*• (H. Allen, 1864)	NA	MN	TH
56	Chiroptera	Vespertilionidae	*Perimyotis subflavus*• (F. Cuvier, 1832)	NA/NT	MN	
57	Chiroptera	Vespertilionidae	*Rhogeessa tumida*• H. Allen, 1866	NA/NT	MN	
58	Cingulata	Dasypodidae	*Dasypus mexicanus* W. C. H. Peters, 1865	NA/NT	IR, SS, IN, CT	TH
59	Didelphimorphia	Didelphidae	*Didelphis virginiana* Kerr, 1792	NA/NT	IR, SS, IN, CT	DB, TH, CTCB[e]
60	Eulipotyphla	Soricidae	*Cryptotis mexicanus*• (Coues, 1877)	NA/Endemic	PF	DB, TH
61	Eulipotyphla	Soricidae	*Sorex altoensis*• Carraway, 2007	NT/Endemic	PF	DB
62	Lagomorpha	Leporidae	*Sylvilagus cunicularius* (G. R. Waterhouse, 1848)	NA/Endemic	CTCB	
63	Lagomorpha	Leporidae	*Sylvilagus floridanus* (J. A. Allen, 1890)	NA/NT	IR, SS, IN, CT	DB, TH
64	Rodentia	Sciuridae	*Glaucomys volans** (Linnaeus, 1758)	NA/NT	IN	
65	Rodentia	Sciuridae	*Otospermophilus variegatus* (Erxleben, 1777)	NA	IR, SS, IN, CT	DB, TH
66	Rodentia	Sciuridae	*Sciurus aureogaster* F. Cuvier in É Geoffroy Saint-Hilaire & F. Cuvier, 1829	NA/NT	IR, SS, IN, CT	DB, TH, CTCB[e]
67	Rodentia	Sciuridae	*Sciurus deppei* W. C. H. Peters, 1864	NA/NT	IR, IN, CT	DB
68	Rodentia	Sciuridae	*Sciurus oculatus** W. C. H. Peters, 1864	NA/Endemic	IR, IN, CT	DB, TH
69	Rodentia	Heteromyidae	*Heteromys irroratus* J. E. Gray, 1868	NA		DB, TH
70	Rodentia	Cricetidae	*Casiomys chapmani*• (O. Thomas, 1898)	NT/Endemic	ST	
71	Rodentia	Cricetidae	*Casiomys alfaroi* (J. A. Allen, 1891)	NT		TH
72	Rodentia	Cricetidae	*Neotoma mexicana* S. F. Baird, 1855	NA/NT		DB, TH
73	Rodentia	Cricetidae	*Peromyscus amplus*• Osgood 1904	NA/Endemic	ST	DB, TH
74	Rodentia	Cricetidae	*Peromyscus aztecus* (de Saussure, 1860)	NA/NT/Endemic		TH
75	Rodentia	Cricetidae	*Peromyscus boylii* (S. F. Baird, 1855)	NA		DB, TH
76	Rodentia	Cricetidae	*Peromyscus collinus*• Hooper, 1952	NA/Endemic	ST	
77	Rodentia	Cricetidae	*Peromyscus gratus*• C. H. Merriam, 1898	NA	ST	DB, TH
78	Rodentia	Cricetidae	*Peromyscus hylocetes* C. H. Merriam, 1898	NA/Endemic		PA[c]
79	Rodentia	Cricetidae	*Peromyscus leucopus* (Rafinesque, 1818)	NA		DB, TH
80	Rodentia	Cricetidae	*Peromyscus levipes*• C. H. Marriam, 1898	NA/Endemic	ST	DB, TH
81	Rodentia	Cricetidae	*Peromyscus zamorae*• Osgood, 1904	NA/Endemic	ST	DB
82	Rodentia	Cricetidae	*Peromyscus mexicanus* (de Saussure, 1860)	NA/NT/Endemic		TH
83	Rodentia	Cricetidae	*Reithrodontomys sumichrasti*• (de Saussure, 1861)	NA/NT/Endemic	ST	
84	Rodentia	Cricetidae	*Reithrodontomys fulvescens* J. A. Allen, 1894	NA/NT		TH
85	Rodentia	Cricetidae	*Sigmodon leucotis*• V. O. Bailey, 1902	NA	ST	DB, TH

a Methods: CT: Camera traps; IN: Interviews; IR: Indirect record; MN: Mist netting; SS: Scent-Station; PF: Pitfall trap; ST: Sherman trap.
b CTCB: Camera Trap and photos from Brigada de vigilancia y monitoreo comunitario del Parque Nacional Los Mármoles; DB; Database; PA: Published article; TH: Thesis.
c Aguilar-López *et al.* 2015a.
d Aguilar-López *et al.* 2019.
e Available at: https://visor.conanp.gob.mx/visor_anp.php.

secured voucher specimens. For scientific collecting, we followed standard recommendations on specimen capture, sacrifice, and preparation (Sikes *et al.* 2016).

Collected small mammals were deposited in the Mammal Collection at the Universidad Autónoma del Estado de Hidalgo (UAEH) and the National Mammal Collection, Universidad Nacional Autónoma de México UNAM (Collection permits SGPA/DGVS/10391, 008327, and 05505/19, granted by the Secretaría de Medio Ambiente y Recursos Naturales).

Medium and large terrestrial mammals. We set up one to 32 camera trap stations per night (Wilview, Stealth Cam, Primos, Reconyx, Cuddeback Attack, Cuddeback LR) with perfume as an attractant, for a total effort of 10,100 tramp/night. Complementary, we set up 486 scent stations, 399 of which were operative during the study, distributed along 28 km of transects. We used fresh fruit, egg, and perfume (unbranded European perfume) as bait to lure

the animals to the stations. We included observations of mammals, dead run-over specimens, carcasses, furs, tracks and feces as indirect records. In addition, we conducted open interviews (Supplementary Data 2) in 2014 and 2015 with local people at 44 localities within Los Mármoles, by selecting the interviewees in the same way as used in the interviews about bats (see above). These interviews aimed to identify which mammal species were known to community members, as well as potential sites to deploy the camera traps, following the observations sites suggested by the interviewees. We used illustrations as a reference for the interviewee (Supplementary Data 2); these were shown at the end of the interview to avoid influencing the participants (García-Alaniz *et al.* 2010).

Literature and databases revision. We checked published literature, gray literature (undergraduate and graduate thesis), and online databases about mammals (using the terms "Parque Nacional Los Mármoles", "mammals", "Hidalgo", and the names of four municipalities where the park is located: "Zimapán" "Jacala" "Pacula" and "Nicolás Flores" and the names of the different mammalian families known to occur in the state): Sistema Nacional de Información sobre Biodiversidad de México (SNIB), iNaturalistMX, and Global Biodiversity Information Facility (GBIF). Searches were performed between July 4–11 2024. Raw data were cleaned by removing duplicate, incomplete, or suspicious records (with missing or dubious information: dates, invalid or missing coordinates), from unsuitable sources or without updated taxonomical information. Specifically, in case of iNaturalistMX dataset, only information tagged as "Research grade" was taken into account. We considered reports found in at least two databases, including any mammal collection, national or international.

Taxonomical list and conservation status. We follow the accepted nomenclature of the American Society of Mammalogists (Burgin *et al.* 2025; MDD 2026), which includes recent taxonomic updates (Calahorra-Oliart *et al.* 2021; Molinari *et al.* 2023; Pérez-Montes *et al.* 2023; Barthe *et al.* 2024; Voss 2024). For their conservation status, we follow national (SEMARNAT 2019) and international norms (IUCN 2025).

Data analysis. We performed rarefaction and extrapolation sampling curves based on Hill numbers to estimate the sample coverage value, and the species richness estimated by extrapolation to twice the sampling effort (Chao *et al.* 2014), for each sampling method. The calculation was performed using species presence-absence data per year in the online version of iNEXT (Chao *et al.* 2016). The curves were generated based on sampling units in order to present the results for all sampling methods in a consistent manner. Accumulation curves based on individuals are recommended for standardized surveys (Gotelli and Colwell 2001), but our results come from different projects with varying sampling efforts across years; therefore, we used the years as the sampling unit (Jiménez-Valverde and Hortal 2003).

Results

We registered 85 mammal species, 76 during fieldwork conducted in collaboration of community brigades, 50 species are corroborated by this study, with only nine species from literature references (eight orders, 20 families, and 56 genera; Table 1) reported for the park. Fifteen species are endemic to Mexico. Species accumulation curves estimated sample coverage values of 0.89 (89%) for the mist nets sampling method, 0.581 (58%) for Sherman traps, and 0.968 (96%) for camera traps. The estimated total species richness, extrapolated to double the sampling effort, was 40, 14, and 28 species, respectively (Figure 2).

Small mammals (bats, shrews, and mice). We captured 1,222 individuals from 37 bat species (Table 1), of which 73 were collected as museum specimens, and the rest were released. Total sampling effort was 389,350 m/net/night (1198 m/net multiplied by 325 hours of netting). We interviewed 148 people, which allowed us to visit 27 diurnal roosts, identified by local people. The most abundant family was Phyllostomidae (n = 983 individuals, 15 species), whereas Vespertilionidae was the most species-rich (n = 18, Table 1 and Figure 3). Most individuals were captured at roosting sites, mainly caves and tunnels. We collected 99 non-volant small mammals belonging to eight species of rodents and two shrews. Sampling effort for small non-volant mammals was 3,200 trap-nights. The most abundant species were the Saxicoline Deermouse, *Peromyscus gratus* C. H. Merriam, 1898 (family Cricetidae), and the Mexican small-eared shrew, *Cryptotis mexicanus* (Coues, 1877) (family Soricidae), respectively (Table 1; Figure 4).

Medium and large mammals. We registered 13 species at scent stations, and we obtained 9,919 pictures and 1,385 videos of 31 species of wild mammals using camera traps (Figure 2), 21,284 pictures, and 3,663 videos of domesticated mammals (*i.e.*, cows: 23,181 photos and videos, dogs: 582, and pigs: 510; Table 2 and Figure 5). Based on the interviews (n = 333), we recorded 25 terrestrial mammal species, including 21 species recorded from 212 incidental records of dead animals, observations, and photographs (Table 1; Figures 3 and 4). Almost all the mammal species suggested by the interviewees were validated using another method (Table 1), except for *Glaucomys volans* (Linnaeus, 1758), which was observed by several members of the community brigade during tree-pruning activities in the forest.

Chiroptera was the best-represented order in the number of species (n = 37; Figure 3), followed by Rodentia (n = 23) and Carnivora (n = 17; Figs. 3 and 4). Ten species are protected by Mexican laws, including *Sciurus oculatus* W. C. H. Peters, 1864 (Subject to Special Protection, Pr), *Glaucomys volans* (Threatened, A), *Herpailurus yagouaroundi* (É. Geoffroy Saint-Hilaire, 1803) (Threatened, A), *Choeronycteris mexicana* von Tschudi, 1844 (Threatened, A), *Leptonycteris nivalis* (de Saussure, 1860) (Threatened, A), *Ursus americanus* Pallas, 1780 (Endangered, P), *Leopardus pardalis* (Linnaeus, 1758) (Endangered, P),

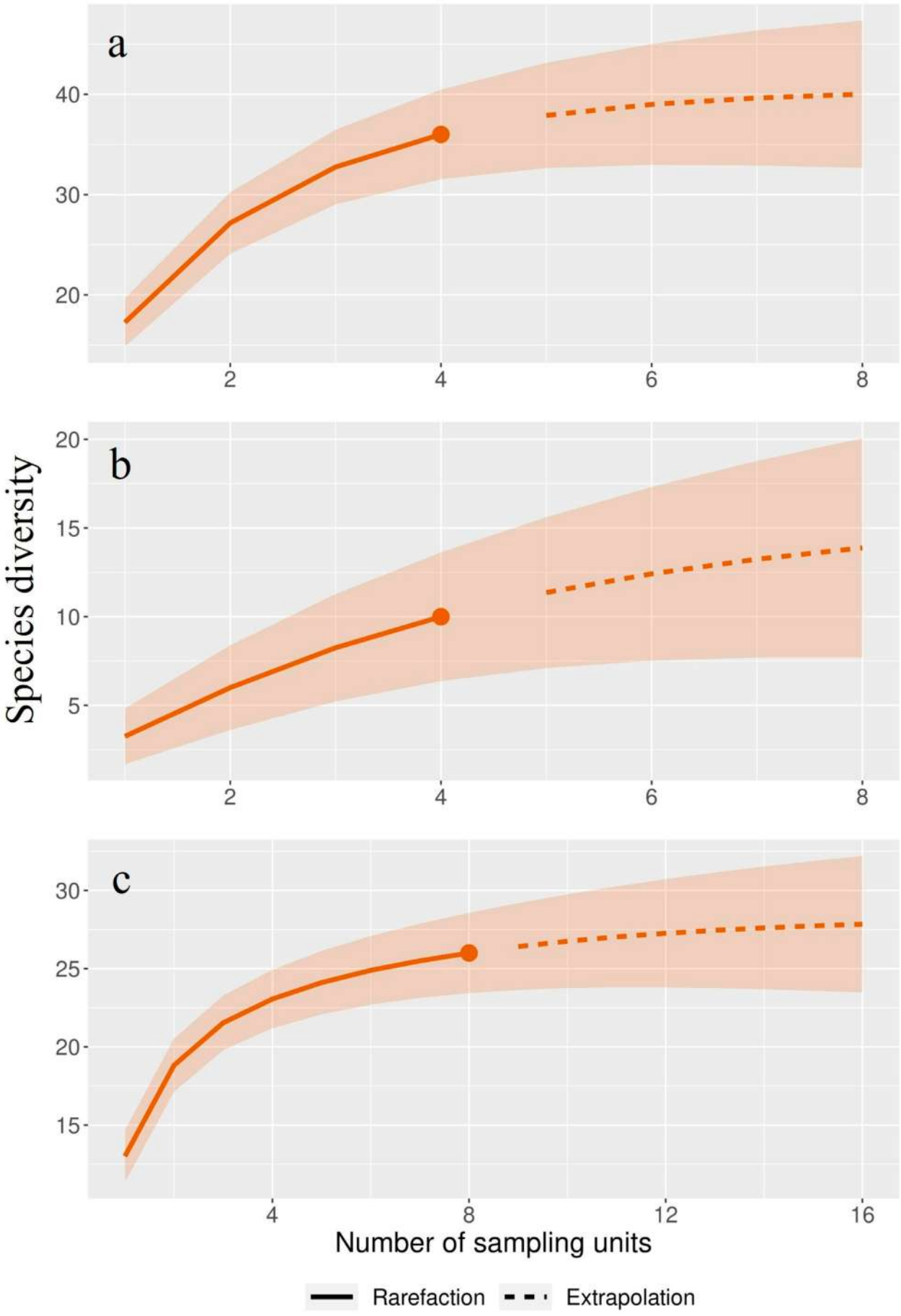

Figure 2. Species accumulation curves of mammals recorded by the sampling methods of a) mist nets, b) Sherman traps, and c) camera traps, for the Los Mármoles National Park.

Figure 3. Some mammals registered within the Los Mármoles National Park. Camera traps: A. *Panthera onca* Linnaeus; B. *Ursus americanus*; C. *Leopardus pardalis*; D. *Eira barbara*. Bats captured by mist-netting: E. *Myotis auriculus*; F. *Myotis yumanensis*; G. *Perimyotis subflavus*; H. *Parastrellus hesperus*. Photos by: M. Aguilar-López and J. Trejo Franco (A, B, D); J. I. Ángeles-Escudero and M. Ramírez (C); M. Aguilar-López (E, F, G, H).

Leopardus wiedii (H. R. Schinz, 1821) (Endangered, P), *Panthera onca* (Linnaeus, 1758) (Endangered, P) and *Eira barbara* (Linnaeus, 1758) (Endangered, P). According to the IUCN Red List, *L. nivalis* is considered endangered (EN), while *L. wiedii, P. onca, C. mexicana, L. yerbabuenae*, and *C. mexicanus* are near threatened (NT). Most species were recorded in areas with dense vegetation cover, including pine-oak forests, oak-pine forests, mixed forests, as well as steep ravines, mainly in the norther portion of Los Mármoles (Figure 1).

Discussion

We presented the first formal mammalian checklist for this protected area that incorporates active sampling, grey

Figure 4. Additional mammals that were reported in this study. A. *Neogale frenata* H. Lichtenstein; B. *Bassariscus astutus*; C. *Mephitis macroura*; D. *Sylvilagus floridanus*; E. *Dicotyles tajacu*; F. *Conepatus leuconotus;* G. *Mazama temama*; H. *Sigmodon leucotis*; I. *Peromyscus amplus*. Photos by: F. Castañón (A); J. Monter-Vargas (B); I. Elizalde Serrano (C); M. Aguilar-López (D, E, F, H, I); Brigada de vigilancia y monitoreo comunitario del Parque Nacional Los Mármoles (G).

literature, databases, and the collaboration of members of the local communities, 90 years after its declaration. Our results show that Los Mármoles harbors >50% of the mammalian fauna reported for the state of Hidalgo (147 spp., Rojas-Martínez *et al.* 2017), which accounts for the importance of this protected area for mammal conservation. The mammal diversity recorded in the park is higher than that reported for other natural protected areas in the central region of Mexico with similar vegetation but a larger surface. For example, the Sierra Gorda Biosphere Reserve (Querétaro, San Luis Potosí, and Guanajuato states), with an area of over 383.5 ha, has 120 reported mammal species (CONANP 1999). Although Los Mármoles represents approximately 6% of it, it harbors almost 67% of

Table 2. Domestic mammal species registered by year in camera traps during this study, in descending order by number of independent records (*i.e.,* pictures and videos), and number of independent records (in parentheses).

	Number of pictures per year						
Species (Family) Common name (in Spanish)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
Bos taurus Linnaeus, 1758 (Bovidae) Vaca, toro	2512 (226)	3124 (580)	4736 (926)	1679 (196)	6646 (590)	4484 (972)	**23181**
Canis familiaris Linnaeus, 1758 (Canidae) Perro	142 (8)	85 (59)	99 (61)	18 (94)	158 (94)	80 (29)	**582**
Sus domesticus Erxleben, 1777 (Suidae) Cerdo, cochino, puerco	31 (6)	82 (31)	0	0	147 (12)	250 (22)	**510**
Equus asinus Linnaeus, 1758 (Equidae) Burro, asno	0	200 (50)	88 (19)	0	116 (33)	8 (3)	**327**
Equus caballus (Equidae) Caballo	6 (4)	38 (22)	11 (8)	0	8 (4)	128 (12)	**191**
Capra hircus Linnaeus, 1758 (Bovidae) Cabra, chivo	0	5 (11)	0	0	16 (11)	8 (5)	**29**
Ovis aries Linnaeus, 1758 (Bovidae) Oveja	0	0	3 (3)	0	25 (31)	2 (2)	**27**
Felis catus Linnaeus, 1758 (Felidae) Gato	6 (1)	0	0	0	3 (1)	0	**9**

its mammalian diversity. Other examples are the protected area Desierto de Los Leones (Mexico City; about 1,500 ha and with 14 mammal species; CONANP 2006), and the Zona Protectora Forestal Vedada Cuenca Hidrográfica del Río Necaxa (Puebla and Hidalgo states; 42,100 ha in extension and with 54 mammal species; CONANP 2013; Atonal-Sandoval 2015). Another important and geographically nearby protected area in the state of Hidalgo, El Chico National Park (hereafter El Chico), has 30 reported mammal species within only 2,734 ha (Hernández-Flores and Rojas-Martínez 2010).

Bats were the most species-rich group registered in this study, including arthropodivorous (23 spp.), nectar-feeding (5), fruit-eating (7), and hematophagous (2) species. The Yuma Myotis [*Myotis yumanensis* (H. Allen, 1864)] specimens captured in Los Mármoles, represent the first record of the species in the state in more than 40 years, since Hall (1981) reported the species in the Tasquillo River, a locality about 30 km from Los Mármoles. We also recorded migratory species, such as *C. mexicana*, *Lasiurus cinereus* (Palisot de Beauvois, 1796)*; Lasiurus frantzii* (1871)*; L. yerbabuenae; L. nivalis;* and *Tadarida brasiliensis* (I. Geoffroy Saint-Hilaire, 1824) (Shump Jr and Shump 1982; Arroyo-Cabrales *et al.* 1987; Pfrimmer-Hensley and Wilkins 1988; Wilkins 1989; Cryan 2003; Cole and Wilson 2006). This indicates that Los Mármoles harbors a rich bat-fauna that varies seasonally, including both migratory and endangered species. Based on our estimates, at least four additional species could be recorded (Figure 2). The use of complementary methods, such as active and passive acoustic monitoring of bat-echolocation calls (MacSwiney *et al.* 2008; 2020), we suggest that the bat-fauna inventory for Los Mármoles might increase rapidly, since such methods improve species records, especially among species that fly higher above ground or in open areas, such as members of the Molossidae or Emballonuridae families (Vaughan 1966; Fenton and Griffin 1997; McCracken *et al.* 2021).

Most of the bats reported here came from individuals captured in caves, which almost half of the Mexican bat species use as refugees (Arita 1993). In addition, species such as *Corynorhinus mexicanus* G. M. Allen, 1916; *Corynorhinus townsendii* (W. Cooper, 1837)*; Eptesicus fuscus* (Palisot de Beauvois, 1796)*; Myotis thysanodes* 1897; *Myotis ciliolabrum* (1886)*; Myotis velifer* (1890); *Myotis volans* (H. Allen, 1866); and *Perimyotis subflavus* (F. Cuvier, 1832) are known to use caves in Mexico for hibernation (Ramos-H. *et al.* 2024). Although no hibernation sites have been identified in Los Mármoles, we cannot rule out that some caves or tunnels might be used as hibernacula for some species since cold caves are abundant and within the elevation range of hibernating bat species in Mexico (Ramos-H. *et al.* 2024).

Small non-flying mammals are likely underrepresented in this study primarily due to the limited duration of the sampling effort, which was solely concentrated in Spring and Summer across different years. Rodents (order Rodentia) were mainly represented by the common and widely distributed genus *Peromyscus* (n = 10 spp.), with *P. gratus*, 1898 as the species with the most captures, unlike what was reported by Hernández-Flores and Rojas-Martínez (2010) in other areas in Hidalgo, where *Peromyscus levipes* 1898 and *Peromyscus amplus* Osgood, 1904 were the most common mice. Rodents are highly abundant and play key ecological roles as seed dispersers/predators and prey for many other mammals (Andersson and Erlinge 1977; Fedriani and Manzaneda 2005; Loayza *et al.* 2014; Godó *et al.* 2022), so their presence may indicate the good condition of the forest in the Los Mármoles. The southern flying squirrel, *G. volans*, is a threatened species only reported by the sighting of local people members of the community brigades that regularly patrol the national park, an example of how important it is to capacitate local people to recognize rare species through environmental and scientific communication programs, such as the ones established in the national park for several years (M. Aguilar-López unpublished data). Until now, no camera traps have been deployed in the canopy, and most of the sampling is focused on medium and large land mammals, underrepresenting arboreal species such as *G. volans*.

Figure 5. Domestic and feral animals registered in this study. A. A cow (*Bos taurus*) and a Coyote (*Canis latrans*); B. A herd of cattle grazing in Los Mármoles, far from human settlements; C. Pig (*Sus domesticus*); D. A pair of Donkeys (*Eqqus asinus*) E. Cow´s leg with bite marks, putatively made by feral dogs (arrows); F. A feral dog (*Canis familiaris*) carrying an armadillo (*Dasypus mexicanus*). Photos by: M. Aguilar-López, G. Flores-Sierra and J. Monter-Vargas.

The number of Soricidae species reported here (*n* = 2) is probably an underestimation of the actual number, primarily due to the difficulty of sampling this taxon and its low capture ratio (Carraway 2007), but the environmental conditions in the pine-oak forests, especially in sites far from cultivated areas or sites of disturbance, can benefit the presence of this group (*i.e.*, Flores-Martínez *et al.* 2024). Considering its geographic location and ecosystems, other shrews that could be in the Los Mármoles include *Notiosorex crawfordi* (Coues, 1877) and *Cryptotis pueblensis* H. H. T. Jackson, 1933 (Guevara *et al.* 2015). It is worth noting that, according to our understanding, these shrew specimens are the first to be collected since their first records in Los Mármoles, almost 130 years ago (Guevara 2021). In addition,

they represent the first specimens deposited in Mexican scientific collections.

We highlight records of jaguar (*Panthera onca*), cougar (*Puma concolor* [Linnaeus, 1771]), black bear (*Ursus americanus*), and other carnivores at the park. Their presence is likely associated with the availability of large prey, such as the collared peccary, *Dicotyles tajacu* (Linnaeus, 1758), and the white-tailed deer, *Odocoileus virginianus* (E. A. W. von Zimmermann, 1780), which are known components of their diet (Gutiérrez-González and López-González 2017; Flores-Turdera *et al.* 2021), as well as the availability of forested habitats and rugged terrain. More than 80% of the carnivore species reported for the state (17 of 21) occur in Los Mármoles, including all the Felidae species present in Mexico. Prey diversity and suitable home ranges may allow large felids such as jaguars and cougars to coexist in Los Mármoles (*i.e*, Ávila-Nájera *et al.* 2016). Still, neither species is available for the area. It is noteworthy to mention that an adult jaguar was recently shot, probably by illegal hunters, and died in captivity in August 2024 (Mota-López 2024).

Felidae is a bioindicator group, suggesting healthy ecosystems in the park, since felids have requirements and characteristics that demand greater food availability and larger foraging areas (Aranda 2000). Ravines and canyons and steep slopes (up to 80% for black bears; Monroy-Vilchis *et al.* 2016) may offer refuge for these mammals. As such, these habitats should be considered mainly for conserving the temperate forests of Los Mármoles, where we find other species threatened by human activity, such as the *Leopardus pardalis*, *L. wiedii, Lynx rufus* [von Schreber, (von Schreber, 1777), and *Eira barbara*.

This study confirms the presence of black bears in the area and provides the first photo-evidence of the species in the state of Hidalgo (Aguilar-López *et al.* 2019). Suitable habitat for *U. americanus* includes coniferous forest between 1500 and 3500 m (Monroy-Vilchis *et al.* 2016), which is present in Los Mármoles, but is decreasing due to illegal logging (Arroyo-Ruiz and Cuevas-Cardona 2017).

Feral dogs likely compete with wild carnivores in the area (Table 2), as we noted many instances of dogs chasing small- and medium-sized mammals, in addition to livestock (Figure 5). Feral dogs have a significant impact on fauna through competition, predation, hybridization with wild canids, disease transmission, and changing the behavior of potential prey -by temporarily avoiding dog areas (Jackman and Rowan 2007; Young *et al.* 2011; Waldstein-Parsons *et al.* 2016) and dogs may represent a potential prey for big cats (Carral-García *et al.* 2021), although no interaction of this type was observed or reported during the interviews. Livestock can cause different effects on biodiversity (through grazing and competition with herbivores; Barroso and Gortázar 2024), and cattle are frequently preyed on by big cats (Burgas *et al.* 2014; Khorozyan *et al.* 2015). Hence, a possible conflict may arise from cattle predation. During our study, we encountered some instances of attacks by dogs to cows and wild mammals (Figure 5).

Species richness in Los Mármoles is influenced by its topographic complexity, including rocky areas and ravines that provide refuge for wildlife, as well as by its vegetation, which represents a transition between lowland and highland habitats (Rzedowski, 1978; Flores-Villela and Gerez, 1994). Chávez and Ceballos (1998) noted that localities in the elevational range between 1,500 and 1,700 m above sea level harbor a mixture of temperate and tropical species, consistent with our findings. The sampling effort is another factor contributing to the marked difference in the richness of the temperate forest areas studied so far. This can indirectly influence the composition of the reported mammal species. For example, our sampling was higher and involved more methods than the study at El Chico (Hernández-Flores and Rojas-Martínez 2010), and a bigger area can harbor large mammal species that need bigger foraging areas, like big cats (Hernández-Flores and Rojas-Martínez 2010; de la Torre *et al.* 2017; Núñez-Pérez and Miller 2019). We emphasize that community brigades have been important in registering a large proportion of the mammals reported in the area. This reinforces the need to involve and train local people in biological monitoring programs within protected areas.

Our research fills the information gap on the biodiversity of Los Mármoles, a long-standing protected area in Mexico that still lacks a management plan. Only 12% (10 spp.) of the mammal fauna in Los Mármoles is considered endangered. Our findings highlight the importance of Los Mármoles for the conservation of keystone and threatened mammal species, particularly Carnivora and Chiroptera, which may be vulnerable to extractive activities such as mining. This sector has historically lobbied for the recategorization of the area Los Mármoles to allow mineral extraction (CONANP 2007). In addition, other anthropogenic activities, such as land-use changes for agriculture and housing, may imperil the survival of some species in the coming years. The presence of livestock and feral fauna, such as dogs, might affect the activity patterns and abundance of some mammal species (by predation, competition, etc.; Zapata-Ríos and Branch 2016; Carrasco-Román *et al.* 2021). Therefore, we consider it necessary to implement improved livestock practices and feral dogs' population control strategies.

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Declaration of Artificial Intelligence use

The authors declare that AI Grammarly software was used to assist with style suggestions, textual clarity, and revision of grammar and syntax in English.

Author contributions

Melany Aguilar-López (MA-L), Pedro Adrián Aguilar-Rodríguez (PAA-R), and Lázaro Guevara (LG) developed the idea and structure. MA-L, PAA-R, LG, and José Luis Aguilar-López (JLA-L) wrote the original draft, reviewed and edited all versions of it. MA-L, LG, Jazmín L. Monter-Vargas (JLM-V), Josefina Ramos-Frías (JR-F), and Jorge I. Ángeles Escudero collected data in the field. MA-L, PAA-R, LG, JLA-L, and JR-F provided data curation and formal analysis of the data. MA-L and LG provided funding.

Supplementary data

SD1. Example of the semi-structured interviews presented to local members of the communities to identify the presence of bat roosts in Los Mármoles National Park.

SD2. Example of the semi-structured interviews presented to local members of the communities to identify the presence of medium- and large mammal species in Los Mármoles National Park.

Literature cited

Aguilar-López M, Rojas-Martínez AE, Cornejo-Latorre C, Sánchez-Hernández C, Vite-Silva VD, and Ramos-Frías J. 2015a. Registros notables de mamíferos terrestres del estado de Hidalgo, México. *Acta Zoológica Mexicana n.s.* 31:403–411. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0065-17372015000300006&lng=es&tlng=es

Aguilar-López M, Ramos-Frías J, Rojas-Martínez AE, and Cornejo-Latorre C. 2015b. First record of jaguar (*Panthera onca*) from the state of Hidalgo, México. *Western North American Naturalist* 74:520–525. https://doi.org/10.3398/064.075.0407

Aguilar-López M, Monter-Vargas JL, Cornejo-Latorre C, and Hernández-SaintMartin A. 2019. First photo evidence of the American black bear (*Ursus americanus*) in the southwestern limit of its distribution. *Western North American Naturalist* 79:124–129. https://scholarsarchive.byu.edu/wnan/vol79/iss1/12

Álvarez-Castañeda ST, Álvarez T, and González-Ruiz N, editors. 2015. *Guía para identificar los mamíferos de México*. Jalisco (MX): Asociación Mexicana de Mastozoología/ Centro de Investigaciones del Noroeste SC.

Álvarez-Zúñiga E, Sánchez-González A, and Valencia-Ávalos S. 2010. Los encinos del Parque Nacional Los Mármoles, Hidalgo, México. *Madera y Bosque* 16:55–66. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-04712010000400004&lng=es&tlng=es

Andersson M, and Erlinge S. 1977. Influence of predation on rodent populations. *Oikos* 29:591–597. https://doi.org/10.2307/3543597

Aranda M. 2000. *Huellas y otros rastros de los mamíferos grandes y medianos de México*. Distrito Federal (MEX): CONABIO/Instituto de Ecología AC.

Aranda M. 2012. Manual para el rastreo de mamíferos silvestres de México. Ciudad de México (MX): Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO).

Arita HT. 1993. Conservation biology of the cave bats of Mexico. *Journal of Mammalogy* 74:693–702. https://doi.org/10.2307/1382291

Arroyo-Cabrales J, Hollander RR, and Knox-Jones Jr. J. 1987. *Choeronycteris mexicana*. *Mammalian Species* 291:1–5. https://doi.org/10.2307/3503823

Arroyo-Ruiz JR, and Cuevas-Cardona C. 2017. Historia ambiental de la Encarnación, Parque nacional Los Mármoles. In: Ramírez Bautista A, Sánchez-González A, Sánchez-Rojas G, and Cuevas-Cardona C, editors. *Biodiversidad del estado de Hidalgo*. Vol. II. Hidalgo (MX): Universidad Autónoma del Estado de Hidalgo; p. 623–634.

Asiain J, Márquez J, and Bueno-Villegas J. 2011. The Staphylinidae (Coleoptera) fauna of Los Mármoles National Park, Hidalgo, Mexico. *The Coleopterists Society* 65:393–402. https://doi.org/10.2307/41413649

Atonal-Sandoval D. 2015. *Mamíferos terrestres de la Cuenca Hidrográfica del río Necaxa, Puebla*. [Bachelor Thesis]. [Puebla (MX)], Benemérita Universidad Autónoma de Puebla.

Ávila-Nájera DM, Chávez C, Lazcano-Barrero MA, Mendoza GD, and Pérez-Elizalde S. 2016. Overlap in activity patterns between big cats and their main prey in northern Quintana Roo, Mexico. *Therya* 7:439–448. https://doi.org/10.12933/therya-16-379

Bagchi S, Namgail T, and Ritchi M. E. 2006. Small mammalian herbivores as mediators of plant community dynamics in the high-altitude arid rangelands of Trans-Himalaya. *Biological Conservation* 127:438–442. https://doi.org/10.1016/j.biocon.2005.09.003

Barroso P, and Gortázar C. 2004. The coexistence of wildlife and livestock. *Animal Frontiers* 14:5–12. https://doi.org/10.1093/af/vfad064

Barthe M, Rancilhac L, Arteaga MC, Feijó A, Tilak MK, Justy F, Loughry WJ, McDonough CM, Thoiry B, Catzeflis F, *et al*. 2024. Exon capture museomics deciphers the nine-banded armadillo species complex and identifies a new

species endemic to the Guiana shield. *Systematic Biology* 74:syae027. https://doi.org/10.1093/sysbio/syae027

Bracamonte JC. 2018. Sampling protocol for the estimation of bat diversity with mist nets in ecological studies. *Ecología Austral* 28:446–454.

Brunet-Rossinni AK, and Wilkinson GS. 2009. Methods for age estimation and the study of senescence in bats. In: Kunz TH, and Parsons S, editors. *Ecological and behavioral methods for the study of bats*. Maryland (EEUU): Johns Hopkins University Pres; p. 315–325.

Burgas A, Amit R, and López BC. 2014. Do attacks by jaguars *Panthera onca* and pumas *Puma concolor* (Carnivora: Felidae) on livestock correlate with species richness and relative abundance of wild prey? *Revista de Biología Tropical* 62:1459–1467.

Burgin CJ, Zijlstra JS, Becker MA, Handika H, Alston JM, Widness J, Liphardt S, Huckaby DG, and Upham NS. 2025. How many mammal species are there now? Updates and trends in taxonomic, nomenclatural, and geographic knowledge. *Journal of Mammalogy* 106:1082–1117. https://doi.org/10.1093/jmammal/gyaf047

Calahorra-Oliart A, Ospina-Garcés SM, and León-Paniagua L. 2021. Cryptic species in *Glossophaga soricina* (Chiroptera: Phyllostomidae): do morphological data support molecular evidence? *Journal of Mammalogy* 102:54–68. https://doi.org/10.1093/jmammal/gyaa116

Carral-García M, Buenrostro I, Weissenberg H, Rosales V, and Pérez-Flores J. 2021. Dog predation by jaguars in a tourist town on the Mexican Caribbean. *Neotropical Biology and Conservation* 16:461–474. https://doi.org/10.3897/neotropical.16.e68973

Carrasco-Román E, Medina JP, Salgado-Miranda C, Soriano-Vargas E, and Sánchez-Jasso JM. 2021. Contributions on the diet of free-ranging dogs (*Canis lupus familiaris*) in the Nevado de Toluca Flora and Fauna Protection Area, Estado de México, Mexico. *Revista Mexicana de Biodiversidad* 92:e923495. https://doi.org/10.22201/ib.20078706e.2021.92.3495

Carraway LN. 2007. Shrews (Eulypotyphla: Soricidae) of Mexico. *Monographs of the Western North American Naturalist* 3:1–91. https://doi.org/10.3398/1545-0228-3.1.1

Castillo-Álvarez A, and Peña-Mondragón JL. 2015. Métodos de investigación social: fundamentos, técnicas y aportaciones para el entendimiento de las relaciones sociedad-vida silvestre. In: Gallina, S, editor, *Manual de técnicas del estudio de la fauna*. Veracruz (MX): Instituto de Ecología, A. C.; p. 189–210.

Chao A, Gotelli NJ, Hsieh TC, Sanders EL, Ma KH, Colwell RK, and Ellison AM. 2014. Rarefaction and extrapolation with Hill numbers: a framework for sampling and estimation in species diversity studies. *Ecological Monographs* 84:45–67. https://doi.org/10.1890/13-0133.1

Chao A, Ma KH, and Hsieh TC. 2016. iNEXT Online: Software for Interpolation and Extrapolation of Species Diversity. Program and User's Guide published at http://chao.stat.nthu.edu.tw/wordpress/software_download/inext-online/

Chávez C, and Ceballos G. 1998. Diversidad y estado de conservación de los mamíferos del Estado de México. *Revista Mexicana de Mastozoología* 3:113–134. https://doi.org/10.22201/ie.20074484e.1998.3.1.63

Chávez-Lugo EG, Ramírez-Albores JE, Pérez-Suárez M, Cruz-Bazan EJ, Encina-Domínguez JA, and Cruz-Anaya A. 2024. Protected and unprotected areas as refuges for bird conservation in Southeastern Coahuila, Mexico. *Conservation* 4:560–576. https://doi.org/10.3390/conservation4040034

Cole FR, and Wilson DE. 2006. *Leptonycteris yerbabuenae*. *Mammalian Species* 797:1–7. https://doi.org/10.1644/797.1

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 1999. *Programa de Manejo Reserva de la Biosfera Sierra Gorda*. Distrito Federal (MX): Instituto Nacional de Ecología.

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2006. *Programa de conservación y manejo Parque Nacional "Desierto de los Leones"*. Distrito Federal (MX): Comisión Nacional de Áreas Naturales Protegidas.

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2007. *Estudio previo justificativo para la modificación del decreto por el que se pretende recategorizar el Parque Nacional Los Mármoles como Área de Protección de Flora y Fauna*. Distrito Federal (MX): Secretaría de Medio Ambiente y Recursos Naturales.

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2013. *Estudio previo justificativo para la modificación de la Declaratoria del Área de Protección de Recursos Naturales "Zona Protectora Forestal Vedada Cuenca Hidrográfica del Río Necaxa" ubicada en los estados de Hidalgo y Puebla. México*. Distrito Federal (MX): Comisión Nacional de Áreas Naturales Protegidas.

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2020. *Lineamientos y directrices para el desarrollo de actividades de monitoreo en las Áreas Naturales Protegidas*. Mexico City (MX): Secretaría del Medio Ambiente y Recursos Naturales.

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2024. *Buscador de datos por Área Natural Protegida.* (Mexico City, Mexico). [Accessed December 10th, 2024]. https://sig.conanp.gob.mx/

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2025. *Sistema de Información, Monitoreo y Evaluación para la Conservación (SIMEC)*. (Mexico City, Mexico). [Accessed November 24th, 2025]. https://simec.conanp.gob.mx/

Cryan PM. 2003. Seasonal Distribution of Migratory Tree Bats (*Lasiurus* and *Lasionycteris*) in North America. *Journal of Mammalogy* 84:579–593. https://doi.org/10.1644/1545-1542(2003)084%3C0579:SDOMTB%3E2.0.CO;2

De la Torre JA, Núñez JM, and Medellín RA. 2017. Spatial requirements of jaguars and pumas in Southern Mexico. *Mammalian Biology* 84:52–60. https://doi.org/10.1016/j.mambio.2017.01.006

Delgadillo-Moya C, Cárdenas-Soriano MA, Gálvez-Aguilar VM, and Sánchez-González A. 2011. Musgos del Parque Nacional Los Mármoles, Hidalgo, México. *Boletín de la Sociedad Botánica de México* 89:19–26.

Dudley N. 2008. *Guidelines for applying protected area management categories*. Gland (CHE): IUCN. https://doi.org/10.2305/IUCN.CH.2008.PAPS.2.en

Escalante T, Rodríguez G, and Morrone JJ. 2004. The diversification of Neartic mammals in the Mexican Transition Zone. *Biological Journal of the Linnean Society* 83:327–339. https://doi.org/10.1111/j.1095-8312.2004.00386.x

Falcón-Brindis A, León-Cortés JL, and Montañez-Reyna M. 2021. How effective are conservation areas to preserve biodiversity in Mexico? *Perspectives in Ecology and Conservation* 19:399–410. https://doi.org/10.1016/j.pecon.2021.07.007

Fedriani JM, and Manzaneda AJ. 2005. Pre- and postdispersal seed predation by rodents: balance of food and safety. *Behavioral Ecology* 16:1018–1024. https://doi.org/10.1093/beheco/ari082

Fenton MB, and Griffin DR. 1997. High-altitude pursuit of insects by echolocating bats. *Journal of Mammalogy* 78:247–250. https://doi.org/10.2307/1382658

Flores-Hernández MA. 2019. *Herpetofauna del Parque Nacional Los Mármoles*. [Bachelor Thesis]. [Pachuca de Soto (MX)]: Universidad Autónoma del Estado de Hidalgo.

Flores-Martínez JJ, Correa LE, Pichardo D, Sánchez-Cordero V, and Guevara L. 2024. An insight into the habitat and population fluctuation of two species of shrews (Eulipotyphla, Soricidae) in a forest-agricultural ecotone of the Trans-Mexican Volcanic Belt. *Mammal Study* 50: 99–104. http://doi.org/10.3106/ms2024-0019

Flores-Turdera C, Ayala G, Viscarra M, and Wallace R. 2021. Comparison of big cat food habits in the Amazon piedmont forest in two Bolivian protected areas. *Therya* 12:75–83. https://doi.org/10.12933/therya-21-1024

Flores-Villela OA, and Gerez P, editors. 1994. *Biodiversidad y conservación en México: vertebrados, vegetación y uso de suelo*. Distrito Federal (MX): Comisión Nacional para el Uso y Conocimiento de la Biodiversidad-Universidad Nacional Autónoma de México.

García-Alaniz N, Naranjo EJ, and Mallory FF. 2010. Human-felid interactions in three mestizo communities of the Selva Lacandona, Chiapas, Mexico: benefits, conflicts and traditional uses of species. *Human Ecology* 38:454–457. https://doi.org/10.1007/s10745-010-9322-6

García-Sánchez CA, Sánchez-González A, and Villaseñor JL. 2014. La Familia Asteraceae en el Parque Nacional Los Mármoles, Hidalgo, México. *Acta Botánica Mexicana* 106:97–116.

Godó L, Valkó O, Borza S, and Déak B. 2022. A global review on the role of small rodents and lagomorphs (Clade Glires) in seed dispersal and plant establishment. *Global Ecology and Conservation* 33:e01982. https://doi.org/10.1016/j.gecco.2021.e01982

Gotelli NJ, and Colwell RK. 2001. Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecology Letters* 4:379–391. https://doi.org/10.1046/j.1461-0248.2001.00230.x

Guevara L. 2021. The legacy of the fieldwork of EW Nelson and EA Goldman in Mexico (1892-1906) for research on poorly known mammals. *History and Philosophy of the Life Sciences* 43:31. https://doi.org/10.1007/s40656-021-00386-7

Guevara L, Cervantes FA, and Sánchez-Cordero V. 2015. Riqueza, distribución y conservación de los topos y las musarañas (Mammalis, Eulipotyphla) de México. *Therya* 6:43–68. https://doi.org/10.12933/therya-15-211

Gurney G, Adams VM, Álvarez-Romero JG, and Cludet J. 2023. Area-based conservation: Taking stock and looking ahead. *One Earth* 6:98–104. https://doi.org/10.1016/j.oneear.2023.01.012

Gutiérrez-González CE, and López-González CA. 2017. Jaguar interactions with pumas and prey at the northern edge of jaguars' range. *PeerJ*, 5:e2886. https://doi.org/10.7717/peerj.2886

Hall ER. 1981. *The mammals of North America. Vol 1 and 2*. New York (EEUU): John Wiley and Sons.

Hernández-Flores SD, and Rojas-Martínez, AE. 2010. Lista actualizada y estado de conservación de los mamíferos del Parque Nacional El Chico, Hidalgo, México. *Acta Zoológica Mexicana, n.s.* 26:563–583. https://doi.org/10.21829/azm.2010.263800

IUCN (The International Union for Conservation of Nature)2025. Red List. Version 2024-2. [Accessed October 10th, 2025]. Available at: https://www.iucnredlist.org

Jackman J, and Rowan AN. 2007. Free-roaming dogs in developing countries: the benefits of capture, neuter, and return programs. In: Salem D, and Rowan A, editors. *The state of the animals*. Washington (USA): Humane Society Press; p. 55–78.

Jiménez-Valverde A, and Hortal J. 2003. Las curvas de acumulación de especies y la necesidad de evaluar la calidad de los inventarios biológicos. *Revista Ibérica de Aracnología* 8:151–161.

Khorozyan I, Ghoddousi A, Soofi M, and Walter, M. 2015. Big cats kill more livestock when wild prey reaches a minimum threshold. *Biological Conservation* 192:268–275.

Kunz TH, Hodgkinson R, and Weisw C. 2009. Methods of capturing and handling bats. In: Kunz TH, and Parsons S, editors. *Ecological and behavioral methods for the study of bats*. Maryland (USA): Johns Hopkins University Pres; p. 36–56.

Kunz TH, Braun de Torrez E, Bauer D, Lobova T, and Flemming TH. 2011. Ecosystem services provided by bats. *Annals of the New York Academy of Sciences* 1223:1–38. https://doi.org/10.1111/j.1749-632.2011.06004.x?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

Larios-Lozano O, Valencia-Hervert J, Bravo-Cadena J, Gúzman-Arias E, and Ortíz-Pulido R. 2017. Aves del

Parque Nacional Los Mármoles, Hidalgo, México. *Revista Mexicana de Biodiversidad* 88:944–959. https://doi.org/10.1016/j.rmb.2017.10.020

LGEEPA(Ley General del Equilibrio Ecológico y la Protección al Ambiente)[. 2024. Diario Oficial de la Federación. CDMX (MX). Last updated: 01 April 2024.

Loayza AP, Carvajal DE, García-Guzmán P, Gutierrez JR, and Squeo FA. 2014. Seed predation by rodents results in directed dispersal of viable seed fragments of an endangered desert shrub. *Ecosphere* 5:1–9. https://doi.org/10.1890/ES13-00283.1

Lorenzo C, Bolaños-Citalán J, Navarrete-Gutiérrez D, Pérez-López JA, and Guevara L. 2019. In search of shrews of Chiapas: analysis of their distribution and conservation. *Therya* 10:121–129. https://doi.org/10.12933/therya.19-717

MacSwiney G MC, Clarke FM, and Racey PA. 2008. What you see is not what you get: the role of ultrasonic detectors in increasing inventory completeness in Neotropical bat assemblages. *Journal of Applied Ecology* 45:1364–1371. https://doi.org/10.1111/j.1365-2664.2008.01531.x?

MacSwiney G MC, Ávila-Flores R, and Pech-Canché JM. 2020. Richness and activity of arthropodophagous bats in an arid landscape of central Mexico. *Therya* 11:23–31. https://doi.org/10.12933/therya-20-900

McCracken GG, Lee YF, Gillam EH, Frick W, and Krauel J. 2021. Bats flying at high altitudes. In*:* Lim BK, Fenton MB, Brigham RM, Mistry S, Kurta A, Gillam EH, Russell A, and Ortega J, editors. *50 Years of Bat Research. Fascinating Life Sciences*. Cham (CHE): Springer; p. 189–205. https://doi.org/10.1007/978-3-030-54727-1_12

MDD (Mammal Diversity Database). 2026. *Mammal Diversity Database (Version 2.4)*. Zenodo. [Accessed April 13th, 2026]. https://www.mammaldiversity.org/

Medellín RA, Arita HT, and Sánchez O. 2008. *Identificación de los murciélagos de México: Clave de Campo*. Distrito Federal (MX): Instituto de Ecología, UNAM.

Mendoza-Vega LA. 2012. *Los Mamíferos del Parque Nacional Los Mármoles, Hidalgo, México*, [Bachelor Thesis]. [Pachuca de Soto (MX)]: Universidad Autónoma del Estado de Hidalgo.

Molinari J, Gutiérrez EE, and Lim BK. 2023. Systematics and biogeography of *Anoura cultrata* (Mammalia, Chiroptera, Phyllostomidae): a morphometric, niche modeling, and genetic perspective, with a taxonomic reappraisal of the genus. *Zootaxa* 5297:151–188. https://doi.org/10.11646/zootaxa.5297.2.1

Monroy-Vilchis O, Castillo-Huitrón NM, Zarco-González MM, and Rodríguez-Soto C. 2016. Potential distribution of *Ursus americanus* in Mexico and its persistence: Implications for conservation. *Journal for Nature Conservation* 29:62–68. https://doi.org/10.1016/j.jnc.2015.11.003

Morrone JJ, Escalante T, and Rodríguez-Tapia G. 2017. Mexican biogeographic provinces: Map and shapefiles. *Zootaxa* 4277:277–229. https://doi.org/10.11646/zootaxa.4277.2.8

Morrone JJ. 2019. Regionalización biogeográfica y evolución biótica de México: encrucijada de la biodiversidad del Nuevo Mundo. *Revista Mexicana de Biodiversidad* 90:e902980. https://doi.org/10.22201/ib.20078706e.2019.90.2980

Mota-López D. 2024. *Muere "Pacus", jaguar rescatado en Pacula, Hidalgo*. El Universal Newspaper. [Accessed 08 September 2024]. Available at: https://www.eluniversal.com.mx/estados/muere-pacus-jaguar-rescatado-en-pacula-hidalgo/

Nuñez-Pérez R, and Miller B. 2019. Movements and home range of Jaguars (*Panthera onca*) and Mountain Lions (*Puma concolor*) in a tropical dry forest of western Mexico. In: Reyna-Hurtado R, and Chapman CA, editors. *Movement Ecology of Neotropical Forest Mammals*. Cham (CHE): Springer International Publishing; p. 243–262.

Pérez-Montes LE, Álvarez-Castañeda ST, and Lorenzo C. 2023. Current status of the *Peromyscus mexicanus* complex in Oaxaca, Mexico. *Therya* 14:85–98. https://doi.org/10.12933/therya-23-2148

Pfrimmer Hensley A, and Wilkins KT. 1988. *Leptonycteris nivalis*. *Mammalian Species* 307:1–4. https://doi.org/10.2307/3504229

Ramírez-Cruz S, Sánchez-González A, and Tejero-Díez D. 2009. La Pteridoflora del Parque Nacional Los Mármoles, Hidalgo, México. *Boletín de la Sociedad Botánica de México* 84:35–44. https://doi.org/10.17129/botsci.2293

Ramos-H D, Marín G, Cafaggi D, Sierra-Durán C, Romero-Ruiz A, and Medellín RA. 2024. Hibernacula of bats in Mexico, the southernmost records of hibernation in North America. *Journal of Mammalogy* 105:823–837. https://doi.org/10.1093/jmammal/gyae027

Randell-Badillo J. 2008. Ordenamiento ecológico territorial regional en los municipios donde se ubica el Parque Nacional Los Mármoles. Informe final SNIB-CONABIO Proyecto No. DQ006. Mexico City (MX): Comisión Nacional de Áreas Naturales Protegidas. [Accessed December 10th, 2024]. Available at: http://www.conabio.gob.mx/institucion/proyectos/resultados/InfDQ006_1a_parte.pdf https://doi.org/10.7550/rmb.33247

Rojas-Martínez AE, Aguilar-López M, Castillo-Cerón J, Cornejo-Latorre C, and Noguera-Cobos O. 2017. Los mamíferos del estado de Hidalgo. In: Ramírez-Bautista A, Sánchez-González A, Sánchez-Rojas G, and Cuevas-Córdoba C, editors. *Biodiversidad del estado de Hidalgo*. Tomo II. Pachuca de Soto (MX): Universidad Autónoma del Estado de Hidalgo, CONACYT, FOMIX; p. 559–576.

Rzedowski J. 1978. *Vegetación de México*. Distrito Federal: (MX): Limusa.

Sánchez-González A, Álvarez ZE, and Tejero-Díez JD. 2010. Richness and distribution patterns of ferns and lycopods in Los Mármoles National Park, Hidalgo, Mexico. *The Journal of the Torrey Botanical Society* 137:373–379. https://doi.org/10.3159/10-RA-002.1

SARH (Secretaría de Agricultura y Recursos Hidráulico) 1994. *Diagnóstico del Parque Nacional Los Mármoles,*

Estado de Hidalgo. Mexico City (MX): Subsecretaría Forestal y de Fauna Silvestre.

SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales). 2019. *Modificación del Anexo Normativo III, Lista de especies en riesgo de la Norma Oficial Mexicana NOM-059-SEMARNAT-2010*. Mexico City (MX): Secretaría del Medio Ambiente y Recursos Naturales.

Shump Jr KA, and Shump U. 1982. *Lasiurus cinereus*. *Mammalian Species* 185:1–5. https://doi.org/10.2307/3503878

Sikes RS, and the Animal Care and Use Committee of the American Society of Mammalogists 2016. Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. *Journal of Mammalogy* 97:663–688. https://doi.org/10.1093/jmammal/gyw078

UNEP-WCMC, and IUCN (United nations Environment Programme, World Commission on Protected Areas, and The International Union for Conservation of Nature) 2021. Protected Planet Report 2020. Gland (CHE), Cambridge (UK). [Accessed on December 12th 2024]. Available at: https://protectedplanetreport2020.protectedplanet.net/chapter-1

Vaughan TA. 1966. Morphology and flight characteristics of molossid bats. *Journal of Mammalogy* 47:249–260. https://doi.org/10.2307/1378121

Villalobos I. 2000. Áreas naturales protegidas: instrumento estratégico para la conservación de la biodiversidad. *Gaceta Ecológica* 54:24–34.

Voss RS. 2024. A New Genus for the "alfaroi group" of *Oryzomys* sensu lato (Rodentia: Cricetidae: Sigmodontinae*). American Museum Novitates* 4030:1–12. https://doi.org/10.1206/4030.1

Waldstein-Parsons A, Bland C, Forrester T, Baker-Whatton MC, Shuttler SG, McShea WJ, Costello R, and Kays R. (2016) The ecological impact of humans and dogs on wildlife in protected areas in eastern North America. *Biological Conservation* 203:75–88. https://doi.org/10.1016/j.biocon.2016.09.001

Wilkins KT. 1989. *Tadarida brasiliensis*. *Mammalian Species* 331:1–10. https://doi.org/10.2307/3504148

Young JK, Olson KA, Reading RP, Amgalanbaatar S, and Berger J. 2011. Is wildlife going to the dogs? Impacts of feral and free-roaming dogs on wildlife populations. *Biological Sciences Faculty Publications* 61:125–132. https://doi.org/10.1525/bio.2011.61.2.7

Zalapa SS, Badii MH, Cervantes FA, and Guerrero F. 2005. Ecología poblacional de *Liomys pictus* en tres áreas de bosque tropical subcaducifolio con diferente tiempo deregeneración, en la costa Norte de Jalisco, México. *Acta Zoológica Mexicana, n.s.* 21:1–14. https://doi.org/10.21829/azm.2005.2121982

Zapata-Ríos G, and Branch LC. 2016. Altered activity patterns and reduced abundance of native mammals in sites with feral dogs in the high Andes. *Biological Conservation* 193:9–16. https://doi.org/10.1016/j.biocon.2015.10.016

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