

# Outstanding records of mammals from two protected areas of central Guerrero, México

## Registros notables de mamíferos en dos áreas protegidas del centro de Guerrero, México

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This work describes outstanding records of 8 threatened mammal species (as per the Official Mexican Norm NOM-059), which are also new records for two protected areas of the central region of the state of Guerrero, México. These species are difficult to observe, have been scarcely studied, and had not been previously recorded in the study area. The study was carried out from July 2018 to July 2019 using 22 camera traps separated from each other by 170 m to 1,300 m in stands of pine-oak forest, oak-pine forest, and low-stature tropical deciduous forest. Photographic records were compared with previous records by entering their coordinates into a geographic information system. *Herpailurus yagouaroundi*, *Leopardus pardalis*, *Leopardus wiedii*, *Lontra longicaudis*, *Panthera onca*, *Coendou mexicanus*, *Spilogale pygmaea*, and *Tamandua mexicana* were recorded both by photo-trapping and direct observations. These mammal species are listed in the Official Mexican Norm NOM-059-SEMARNAT-2020. Our results significantly contribute to expand the knowledge of mammals of the state of Guerrero, México. No information on the presence of these species in the study area or nearby locations was available prior to our study. The confirmed presence of these species in the study area is an indicator of its conservation status.

**Key words:** Carnivores; conservation; photo-trapping; voluntary conservation areas; wildlife.

Se describen registros notables de 8 especies de mamíferos en categorías de riesgo de acuerdo con la Norma Oficial Mexicana NOM-059, los cuales son nuevos para 2 áreas naturales protegidas de la región centro de Guerrero, México. Estas especies son difíciles de observar y hay pocos estudios, por lo que no se cuenta con registros previos en la zona de estudio. El estudio se realizó entre julio 2018 y julio 2019 con 22 cámaras trampa distribuidas en bosque de pino-encino, bosque de encino-pino, y selva baja caducifolia con un rango de separación entre las mismas de 170 m a 1,300 m. Se compararon los registros fotográficos con registros previos mediante el ingreso de coordenadas a un sistema de información geográfica. Se registró mediante foto-trampeo y observación directa a *Herpailurus yagouaroundi*, *Leopardus pardalis*, *Leopardus wiedii*, *Lontra longicaudis*, *Panthera onca*, *Coendou mexicanus*, *Spilogale pygmaea* y *Tamandua mexicana*; estos mamíferos están incluidos como especies en categoría de riesgo de acuerdo con la Norma Oficial Mexicana NOM-059-SEMARNAT-2020. Nuestros resultados son de relevancia para el conocimiento mastozoológico en el estado de Guerrero; antes del presente trabajo no se contaba con información sobre la presencia de estas especies en el área de estudio ni en localidades cercanas. El registro de estas especies sugiere un indicador del buen estado de conservación de la zona estudiada.

**Palabras clave:** Áreas de conservación voluntaria; carnívoros; conservación; fauna silvestre; foto-trampeo.

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In México, mammals have been affected by land-use change, poaching, and illegal trafficking ([Lira-Torres et al. 2014](#)). In response, Protected Areas (PAs) have been created as a major conservation strategy ([Bello and Estrada-Lugo 2012](#)). This study was conducted in 2 PAs in the municipality of Chilpancingo de los Bravo, state of Guerrero, México: the El Borbollón, La Pandura y La Yerbabuena Voluntary Conservation Area (VCA), owned by the Azinyahualco ejido, and the Los Olivos State Reserve, in ejido La Esperanza.

The 2011 decree of Los Olivos PA ([Gobierno del Estado de Guerrero 2010](#)) mentioned the presence of 4 mammal species listed in NOM-059-SEMARNAT-2020 ([SEMARNAT 2020](#)): jaguarundi (*Herpailurus yagouaroundi*), ocelot

(*Leopardus pardalis*), margay (*L. wiedii*), and the Northern tamandua (*Tamandua mexicana*). However, the decree neither state the type of observations that support this claim nor whether historical sightings by inhabitants of the La Esperanza town were reviewed. Thus, it was not entirely certain whether the above-mentioned species were indeed present in Los Olivos. No published information on mammal species occurring in El Borbollón, La Pandura y La Yerbabuena VCA is available. Both PAs are managed by their respective local communities. The lack of biological data for these PAs reflects the overall scarcity of information on the mammals of the state of Guerrero. Our study aimed at identifying mammal species listed

in NOM-059-SEMARNAT-2020 that have been recorded in these PAs. This is an effort to assess the conservation status and envision action plans to preserve the integrity and complexity of the habitats therein.

Los Olivos PA (1,243 ha) and El Borbollón, La Pandura y La Yerbabuena VCA (817 ha) are located contiguous to each other, 80 km southwest of Chilpancingo City, in the state of Guerrero, on the Sierra Madre del Sur mountain range. The predominant vegetation types are low-stature tropical deciduous forest, pine-oak forest, and oak-pine forest (Miranda and Hernández-Xolocotzi 1963). A semi-warm humid climate prevails at the lower elevations of both PAs, and a temperate humid climate in the higher parts (INEGI 2008). Elevation ranges from 950 to 2,000 m and soils are of volcanic and sedimentary origin (INEGI 2007).

Twenty-two photo-trapping stations fitted with Cuddeback E3 cameras were placed in the study area, separated from each other by 170-1,300 m. The motion-activated cameras were placed approximately 50 cm above the ground (Chávez et al. 2013) and set to shoot a 20-megapixel picture followed by a 20-second 720p video and then a 30-second pause for the sensor to reactivate, during the day and nighttime; no attractant was used. Sites for trap placement were chosen *a priori* aiming to sample the three vegetation types, proportionally to the extent of the PAs, along trails located away from commonly used paths to prevent camera traps from being vandalized or stolen (Figure 1; Table 1). Camera traps experienced occasional malfunctioning; each camera trap was operational for 232 ± 15 days on average over the 12-month study period (July 2018 to July 2019), for a total sampling effort of 5,103 trap-days, as per the analysis conducted with the program CAMERASWEET of the Small Wild Cat Conservation Foundation (SWCCF 2020).

The species recorded were identified using specialized literature (Reid 2009; Ceballos and Oliva 2005); the nomenclature follows Ramírez-Pulido et al. (2014). We searched the Unidad de Informática para la Biodiversidad (Information Unit for Biodiversity; UNIBIO 2020) and the Global Biodiversity Information Facility (GBIF 2021) digital databases for records of mammal species listed in NOM-059-SEMARNAT-2020 for the study area. Records that included geographic coordinates of collection localities were entered into a geographic information system using the software QGIS version 3.14 (2020) to compare them with previous records from the study area (Figure 2).

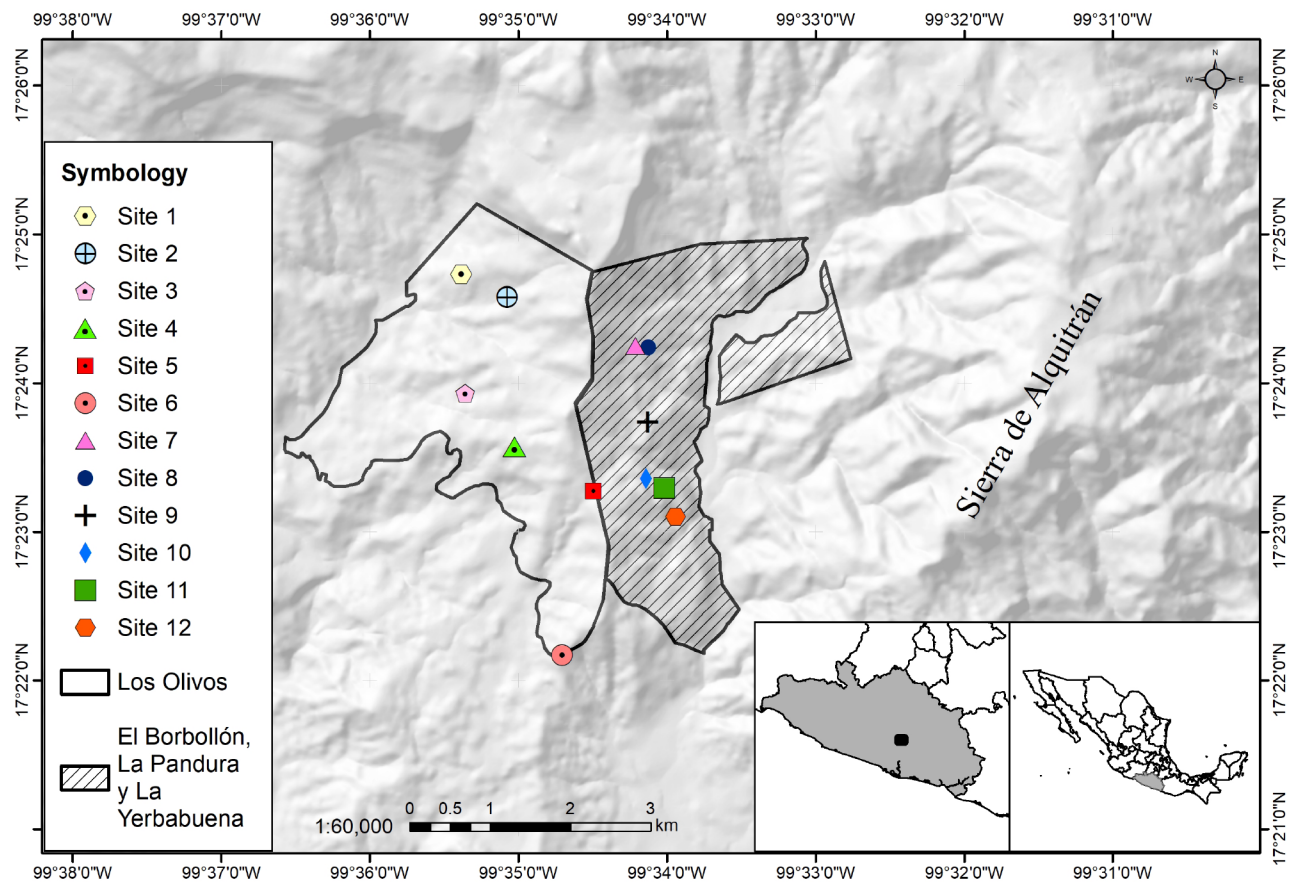
Wild mammals were recorded in all sampling sites. The following species were recorded in sites No. 13 to No. 22 (Table 1): ringtail (*Bassariscus astutus*), American hog-nosed skunk (*Conepatus leuconotus*), nine-banded armadillo (*Dasyurus novemcinctus*), Virginia opossum (*Didelphis virginiana*), white-nosed coati (*Nasua narica*), white-tailed deer (*Odocoileus virginianus*), Eastern collared peccary (*Dicotyles crassus*), raccoon (*Procyon lotor*), Mexican gray squirrel (*Sciurus aureogaster*), and gray fox (*Urocyon cinereoargenteus*). Since we focused on records of mammal species

**Table 1.** Geographic coordinates of the photo-trapping stations deployed in the Los Olivos State Reserve and the El Borbollón, La Pandura y La Yerbabuena Voluntary Conservation Area (BYP), state of Guerrero, México. Stations shown in boldface recorded mammal species listed in the Official Mexican Norm NOM-059-SEMARNAT-2020. ANP = Protected Area. Vegetation types: BEP = oak-pine forest, BPE = pine-oak forest, SBC = low-stature deciduous tropical forest.

Photo-trapping stations	Longitude (W)	Latitude (N)	ANP	Vegetation types
<b>1</b>	<b>99° 35' 22.99"</b>	<b>17° 24' 43.87"</b>	<b>Los Olivos</b>	<b>BEP</b>
<b>2</b>	<b>99° 35' 04.60"</b>	<b>17° 24' 34.69"</b>	<b>Los Olivos</b>	<b>SBC</b>
<b>3</b>	<b>99° 35' 21.50"</b>	<b>17° 23' 55.87"</b>	<b>Los Olivos</b>	<b>BPE</b>
<b>4</b>	<b>99° 35' 01.56"</b>	<b>17° 23' 34.36"</b>	<b>Los Olivos</b>	<b>BPE</b>
<b>5</b>	<b>99° 34' 29.77"</b>	<b>17° 23' 16.41"</b>	<b>Los Olivos</b>	<b>SBC</b>
<b>6</b>	<b>99° 34' 42.46"</b>	<b>17° 22' 10.25"</b>	<b>Los Olivos</b>	<b>BPE</b>
<b>7</b>	<b>99° 34' 12.87"</b>	<b>17° 24' 14.93"</b>	<b>BYP</b>	<b>BEP</b>
<b>8</b>	<b>99° 34' 07.53"</b>	<b>17° 24' 14.43"</b>	<b>BYP</b>	<b>BPE</b>
<b>9</b>	<b>99° 34' 07.95"</b>	<b>17° 23' 44.22"</b>	<b>BYP</b>	<b>BEP</b>
<b>10</b>	<b>99° 34' 08.65"</b>	<b>17° 23' 21.46"</b>	<b>BYP</b>	<b>BEP</b>
<b>11</b>	<b>99° 34' 01.19"</b>	<b>17° 23' 17.72"</b>	<b>BYP</b>	<b>SBC</b>
<b>12</b>	<b>99° 33' 56.52"</b>	<b>17° 23' 05.99"</b>	<b>BYP</b>	<b>SBC</b>
13	99° 34' 57.99"	17° 24' 3.23"	Los Olivos	SBC
14	99° 35' 4.17"	17° 24' 13.26"	Los Olivos	SBC
15	99° 35' 21.48"	17° 24' 10.41"	Los Olivos	BPE
16	99° 35' 19.37"	17° 23' 34.57"	Los Olivos	BPE
17	99° 34' 36.86"	17° 23' 14.61"	Los Olivos	BEP
18	99° 33' 48.87"	17° 24' 7.90"	BYP	BPE
19	99° 34' 15.23"	17° 24' 6.43"	BYP	SBC
20	99° 33' 54.35"	17° 23' 22.78"	BYP	SBC
21	99° 33' 36.73"	17° 22' 27.96"	BYP	SBC
22	99° 34' 0.26"	17° 22' 24.92"	BYP	SBC

listed in NOM-059-SEMARNAT-2020, Table 2 shows the species recorded in sites No.1 to No.12 where such species occurred. Our photo trap records documented (Figure 3) the presence of the following species in the study area: jaguarundi (*H. yagouaroundi*), ocelot (*L. pardalis*), margay (*L. wiedii*), jaguar (*Panthera onca*), Mexican hairy dwarf porcupine (*Coendou mexicanus*), pygmy spotted skunk (*Spilogale pygmaea*), and Northern tamandua (*T. mexicana*). Additionally, the presence of the neotropical otter, *Lontra longicaudis*, in the Los Olivos state reserve was documented both by direct observation and through excreta (Figure 3h). The four felid species were recorded in both PAs in the three vegetation types, with varying frequency and time of occurrence (Table 2). *Herpailurus yagouaroundi* was recorded between April and June 2019 (Figure 3b); *L. wiedii*, between October 2018 and June 2019 (Figure 3c); *P. onca*, between March and May 2019 (Figure 3d); and *L. pardalis*, from August 2018 to June 2019 (Figure 3a). The latter was recorded with cubs on five occasions (Figure 3a).

*Spilogale pygmaea* was recorded in both PAs, but only in pine-oak and oak-pine forests, in May, July, and August 2019 (Figure 3e). *Coendou mexicanus* was observed only once in



**Figure 1.** Map showing the location of Los Olivos and El Borbollón, La Pandura y La Yerbabuena protected areas in the municipality of Chilpancingo de Los Bravo, state of Guerrero, México, and photo-trapping stations where records were made.

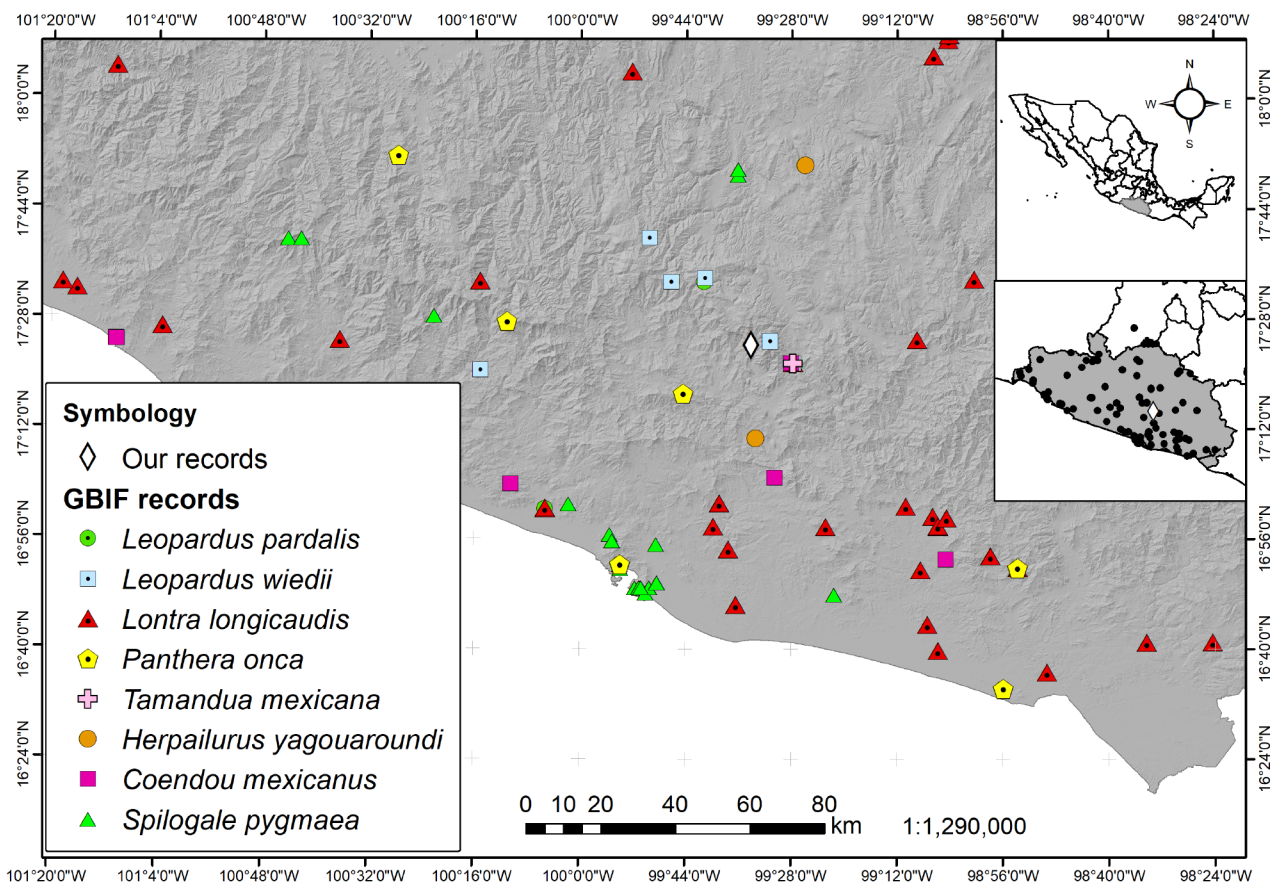
the low-stature tropical deciduous forest in May (Figure 3f). Similarly, *T. mexicana* was recorded only in the low-stature tropical deciduous forest (Figure 3g), once in September 2018 and then in May 2019 (Table 2). *Lontra longicaudis* was directly observed during a camera-trap maintenance visit to Los Olivos State Reserve; excreta from *L. longicaudis* were also found some 4 m from the direct observation location (Figure 3h) on the margin of La Esperanza river (coordinates 17° 24' 46.91" N, 99° 35' 40.06" W).

Assessing the presence of predators and species sensitive to habitat degradation in the study area contributes to broadening the knowledge of mammals of the state of Guerrero; few studies addressing this group have been conducted in this part of the country in recent years. The nearest previous record of *S. pygmaea* is from a location 4 km east of the Xochipala locality, some 45 km north of our study sites; this skunk prefers low-elevation areas mainly covered by low-stature tropical deciduous

**Table 2.** Mammal species listed in the Official Mexican Norm NOM-059-SEMARNAT-2020 recorded in photo-trapping stations in the Los Olivos State Reserve and the El Borbollón, La Pandura y La Yerbabuena Voluntary Conservation Area (BYP), number of records, and vegetation types where they were recorded. ANP = Protected Area. Conservation status: A = threatened, P = endangered, Pr = subject to special protection. Vegetation types: SBC = low-stature deciduous tropical forest, BEP = oak-pine forest, BPE = pine-oak forest.

Species	ANP	Photo-trapping stations	Vegetation types	Number of records	Conservation status
<i>Herpailurus yagouaround</i>	Los Olivos, BPY	5, 4, 7, 8	SBC, BEP, BPE	5	A
<i>Leopardus pardalis</i>	Los Olivos, BPY	4, 7, 8, 9, 10, 11, 12	SBC, BEP, BPE	18	Pr
<i>Leopardus wiedii</i>	Los Olivos, BPY	1, 2, 3, 5, 6, 7	SBC, BEP, BPE	10	Pr
<i>Panthera onca</i>	Los Olivos, BPY	5, 6, 9	SBC, BEP, BPE	6	P
<i>Coendou mexicanus</i>	BPY	11	SBC	1	A
<i>Spilogale pygmaea</i>	Los Olivos, BPY	1, 8, 9	BEP, BPE	9	A
<i>Tamandua mexicana</i>	BPY	12	SBC	2	P
<i>Lontra longicaudis</i>	Los Olivos	No station	SBC	1	A





**Figure 2.** Map showing the location of previous records of mammal species located within or near the study area in the state of Guerrero, México, as retrieved from online databases and the literature. The white symbol shows the location of the study area.

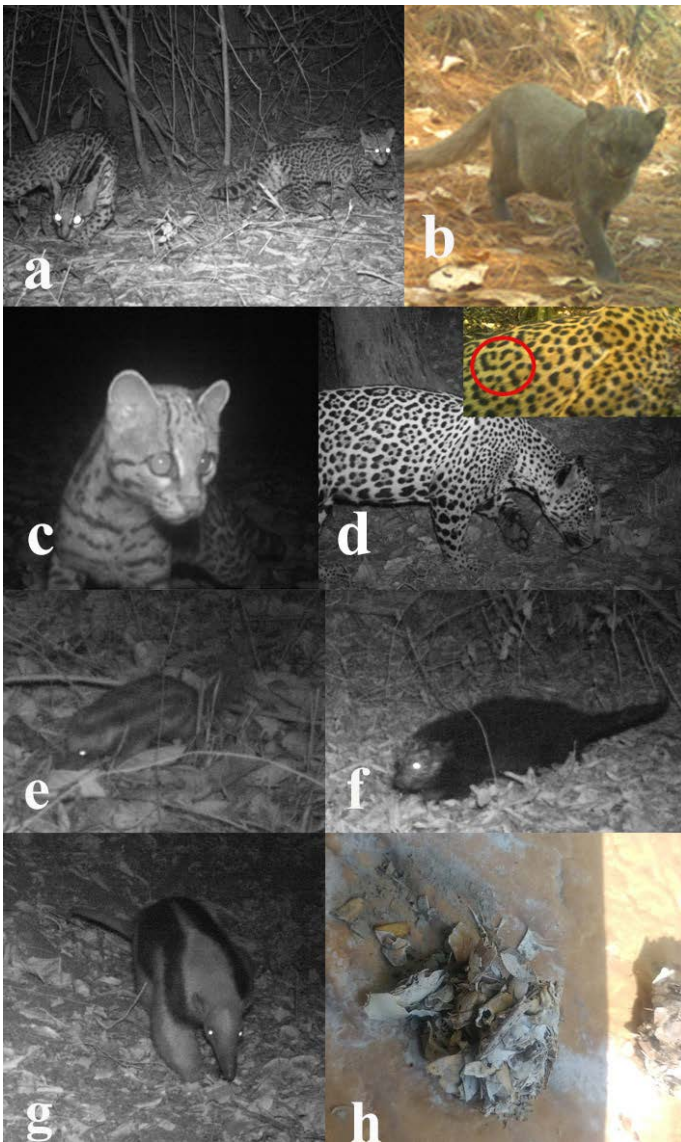
forest (Medellín et al. 1998; Ceballos and Miranda-Sánchez 2000). However, we recorded *S. pygmaea* more frequently in oak-pine forests in both PAs at elevations from 1,374 to 1,580 m. This is the first record of this species in high elevation areas of the state of Guerrero, outside its known distribution range (Lavariega and Briones-Salas 2019).

As per the GBIF database (2021), the nearest previous record of *P. onca* is a footprint found near the Carrizal town, some 20 km south of our study area, which was reported to the iNaturalist platform in 2018. The home range of *P. onca* males can reach up to 90 km<sup>2</sup>, depending on the abundance of prey (Chávez et al. 2005); thus, the ranges of the two jaguars that we recorded are unlikely to overlap the range of this previous record. In addition, this was the only species for which we were able to differentiate individuals based on their spot patterns (Figure 3d); we were also able to determine that one of these individuals was a male, but the sex of the other is unknown.

A record of *H. yagouaroundi* 22 km south of our study area on the México-Acapulco highway, 3 km northwest of the Tierra Colorada town, in low-stature tropical deciduous forest and maize crop fields is reported by Almazán-Catalán et al. (2013). This felid is widely distributed in different habitat types, but most records are from elevations below 1,000 m (Oliveira-Gomes 1998; Aranda-Sánchez 2005a). We made a few records of *H. yagouaroundi* in oak-pine for-

est and low-stature tropical deciduous forest at elevations ranging between 1,519 and 1,628 m. One *L. wiedii* specimen was captured using a Tomahawk trap 6 km east of our study area at an elevation of 2,560 m (Almazán-Catalán et al. 2013). The home range of an adult *L. wiedii* can reach up to 11 km<sup>2</sup> (Aranda-Sánchez 2005b); thus, the ranges of the jaguarundis recorded in our study area are also unlikely to overlap the range of this previous record. Although the distance between the previous record and ours is relatively short, confirming the continued presence of this endangered species in the study area is a key finding.

*Coendou mexicanus* had been previously recorded some 12 km east of our study area, in the Acahuizotla town at 860 m (GBIF 2021). This locality is separated from our study sites by the Sierra de Alquitrán mountain range. The arboreal habits of this rodent make its recording by camera traps set near the ground unlikely, while its nocturnal habits make direct observations difficult (Juárez-G. 2005). One record of *L. pardalis* was retrieved from the GBIF database; the record was obtained 21 km to the northwest of our study area in the Omiltemi town but does not include any other information. Ocelots can inhabit a wide range of habitats and are generally found at elevations below 1,200 m (Murray and Gardner 1997). Our 18 records were made at elevations from 1,400 to 1,580 m; one shows a cub with its mother (Figure 3a). *Tamandua mexicana* had been previously recorded



**Figure 3.** Photographic records of wild mammals in El Borbollón, La Pandura y La Yerbabuena and Los Olivos protected areas in the state of Guerrero, México. a) *Leopardus pardalis*, b) *Herpailurus yagouaroundi*, c) *Leopardus wiedii*, d) *Panthera onca*, e) *Spilogale pygmaea*, f) *Coendou mexicanus*, g) *Tamandua mexicana*, h) excreta of *Lontra longicaudis*.

13 km east of our camera site No. 12 (Table 1) at an elevation of 860 m; our record was made at 1,300 m, while most records reported in the literature were made below 1,000 m (Navarrete and Ortega 2011).

*Lontra longicaudis* was the only species that we were able to record by both direct observation and through signs found on the riverbank. The nearest previous record was made 14 km east of La Esperanza river, separated from our study area by the foothills of the Sierra de Alquitrán mountain range. Since river otters generally stay close to water bodies (Larivière 1999), it is likely that separate populations exist on both sides of Sierra de Alquitrán. This record is important as it documents the conservation of this threatened species (Gallo-Reynoso 1997) in the PA.

The UNIBIO (2020) and GBIF (2021) databases contain few records of mammal species from the state of Guerrero and these do not include additional observations such as

those recorded in our study. Thus, in addition to this publication, our records will be uploaded to the iNaturalist platform. Since iNaturalist is linked to the GBIF database, this will help to continue the systematization and publication of records to enhance the knowledge on mammals of the state of Guerrero.

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