

Record of margay (*Leopardus wiedii*) in a periurban Ecological Reserve in the central mountain region of Veracruz, Mexico

Registro de margay (*Leopardus wiedii*) en Reserva Ecológica periurbana en la zona montañosa del centro de Veracruz, México

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Biodiversity worldwide is affected by human activities, species that inhabits in Protected Natural Areas are not exempt to human impact. Habitat resources are limited, species that requires large territories and a constant food availability cannot survive for long. The objective of this work is to point out and describe the occasional record of a specimen of margay (*Leopardus wiedii*) as a result from a systematic long-term survey in the periurban Ecological Reserve “La Martinica”, in the central mountainous area of the state of Veracruz (Mexico). For about 25 months (May 2021 to June 2023), a non-invasive survey focused on terrestrial and arboreal mammals was deployed in “La Martinica”. The camera traps were installed at ground (terrestrial stations) and in the canopy (arboreal stations), with an average distance of 300 m between them. The 24-hour cycles in which each camera operated correctly and uninterruptedly were considered 1 trap-day. After a sampling effort of 2,525 trap days, and an effective sampling area of 0.5 km², in January 2023, at an altitude of 1,553 m, a specimen of margay was recorded in “La Martinica”. Due to the presence of other carnivores (exotic, introduced, and native) and the scarce mammal diversity at the study site ($n = 12$ species), it is unlikely that a resident population of *Leopardus wiedii* inhabit in the region. The specimen was probably passing through during its dispersal. This record is the northernmost of the species obtained through systematic monitoring in the state of Veracruz.

Key words: Carnivore; feline; mammal; Neotropics; scansorial.

Globalmente la biodiversidad es afectada por actividades antrópicas, especies que habitan Áreas Naturales Protegidas no están exentas del impacto humano. Los recursos en un hábitat son limitados, especies que requieren una disponibilidad constante de recursos alimentarios y espaciales no pueden perdurar mucho tiempo. El objetivo de este trabajo es señalar y describir el registro ocasional de un espécimen de margay (*Leopardus wiedii*), resultado de un monitoreo extensivo en la Reserva Ecológica periurbana “La Martinica”, en la zona montañosa central del Estado de Veracruz (México). Durante poco más de 25 meses (Mayo 2021 a Junio 2023) se implementó un monitoreo no invasivo enfocado en mamíferos arborícolas y terrestres. Las cámaras-trampa se instalaron a nivel del suelo y en dosel, a una distancia promedio de 300 m entre ellas. Ciclos de 24 hr en que cada cámara funcionó correcta e ininterrumpidamente fueron considerados 1 día-trampa. Después de un esfuerzo de muestreo de 2,525 días-trampa, y un área efectiva de muestreo de 0.5 km², en Enero de 2023, se registró un espécimen de margay en “La Martinica”. Debido a la presencia de otros carnívoros (exóticos- introducidos y nativos) y a la escasa riqueza mastozoológica en la localidad de estudio ($n = 12$ especies), es poco probable que exista una población residente de *Leopardus wiedii* en la región. El espécimen probablemente estaba de paso durante su proceso de dispersión. El registro obtenido es el más septentrional de la especie obtenido mediante un monitoreo sistematizado en el estado de Veracruz.

Palabras clave: Carnívoro; escansorial; felino; mamífero; Neotrópico.

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The impacts of anthropogenic activities as the increase of human population, growth of human settlements, change in land use, generation of waste have altered the biotic and abiotic factors available to biodiversity ([Vázquez and Gaston 2006](#)), which implies unprecedented threats to multiple species of flora and fauna throughout the world. Despite several conservation efforts to establish Protected Natural Areas, these locations are also subject to intense anthropogenic pressure ([Jones et al. 2018](#)).

One of the most critical threats to wildlife populations is the habitat loss ([Wright 2005](#)), due to the considerable resource requirements and low population densities mammalian carnivores could be specially vulnerable to habitat destruction ([Crooks et al. 2011](#)).

Among the six species of felines recorded in Mexico, the margay (*Leopardus wiedii*) is the smallest, adult specimen weighs less than 5 kg ([de Oliveira 1998](#)), is also the only one physiologically adapted to arboreal life ([Sunquist](#)



Figure 1. Photo capture of *Leopardus wiedii* (margay) in "La Martinica" Ecological Reserve, obtained in January of 2023.

and Sunquist 2002). In Mexico, the species is classified as "Endangered" by the Norma Oficial Mexicana NOM-059 (SEMARNAT 2010). Human activities as agriculture, livestock raising, and infrastructure development are the principal threats to the species, as they fragment and reduce the available habitat (Ávila-Nájera *et al.* 2024).

Although the extensive distribution of *L. wiedii* across the American Continent its detection rates are universally low (Harmsen *et al.* 2021), for that reason, population dynamics studies of *L. wiedii* are scarce, the data are focused on estimates of relative abundance. Camera traps are one of the most versatile and widely used tools for survey terrestrial mammals, and demonstrate the presence of rarest or elusive terrestrial species (Wearn *et al.* 2013) in a locality. The objective of this work is to point out and describe the occasional camera-trap record of *L. wiedii* in the periurban Ecological Reserve "La Martinica", located in the central mountainous area of the state of Veracruz (Mexico). Additionally, digital repositories of biological information were consulted in search of records of *L. wiedii* in the state of Veracruz (during the XXI Century) to determine the exceptionality of the photo-capture obtained.

The record obtained in January 2023 is the result of a long-term survey with camera traps focused on terrestrial and arboreal mammals, which began in May 2021 in the periurban Ecological Reserve "La Martinica" (19° 35' 12.4" N, 96° 57' 8.6" W; altitude between 1,550 to 1,650 m, and an area of 0.52 km²), located and partially surrounded by the municipality of Banderilla, Veracruz. The vegetation of

the region is composed by tropical and subtropical humid broadleaf forests (Olson *et al.* 2001); within the Ecological Reserve there are disturbed remnants of mesophilic mountain forest. The climate is semi-warm-humid (Cfb, Kottek *et al.* 2006), the average annual rainfall is 1,100 to 1,600 mm, the temperature ranges from 18 °C to 24 °C, the dry season occurs between November and April, the rainy season occurs between May and October (INEGI 2010).

In January of 2023, five camera stations (composed by one camera trap) were installed within the vegetation of "La Martinica", far from human trails (at a distance between six and 20 m). All the camera traps were set up to obtain only photographic records, the camera stations were unbaited, the distance between cameras was on average 300 m to avoid spatial overlapping between sampling areas. The terrestrial stations ($n = 2$; Model Terra8, Wildgame INNOVATIONS®, Texas, EE. UU.), were installed at an average height of 50 cm due to the slope of the soil. The arboreal stations ($n = 3$; Model BTC-7A, Browning®, Utah, EE. UU.) were installed at an average height of six meters. The 24-hour cycles in which each camera worked correctly and uninterruptedly were considered one trap-day; the effective sampling area of each camera station corresponded to a circle of 300 m in diameter (equals to an area of 0.07 km²; individual camera buffer method; Silver *et al.* 2004); the camera stations were relocated every 60 days to completely survey the area of "La Martinica". In order to determine the exceptionality of the record, a search was carried out for sightings of *L. wiedii* in the state of Veracruz obtained during the XXI Century. The

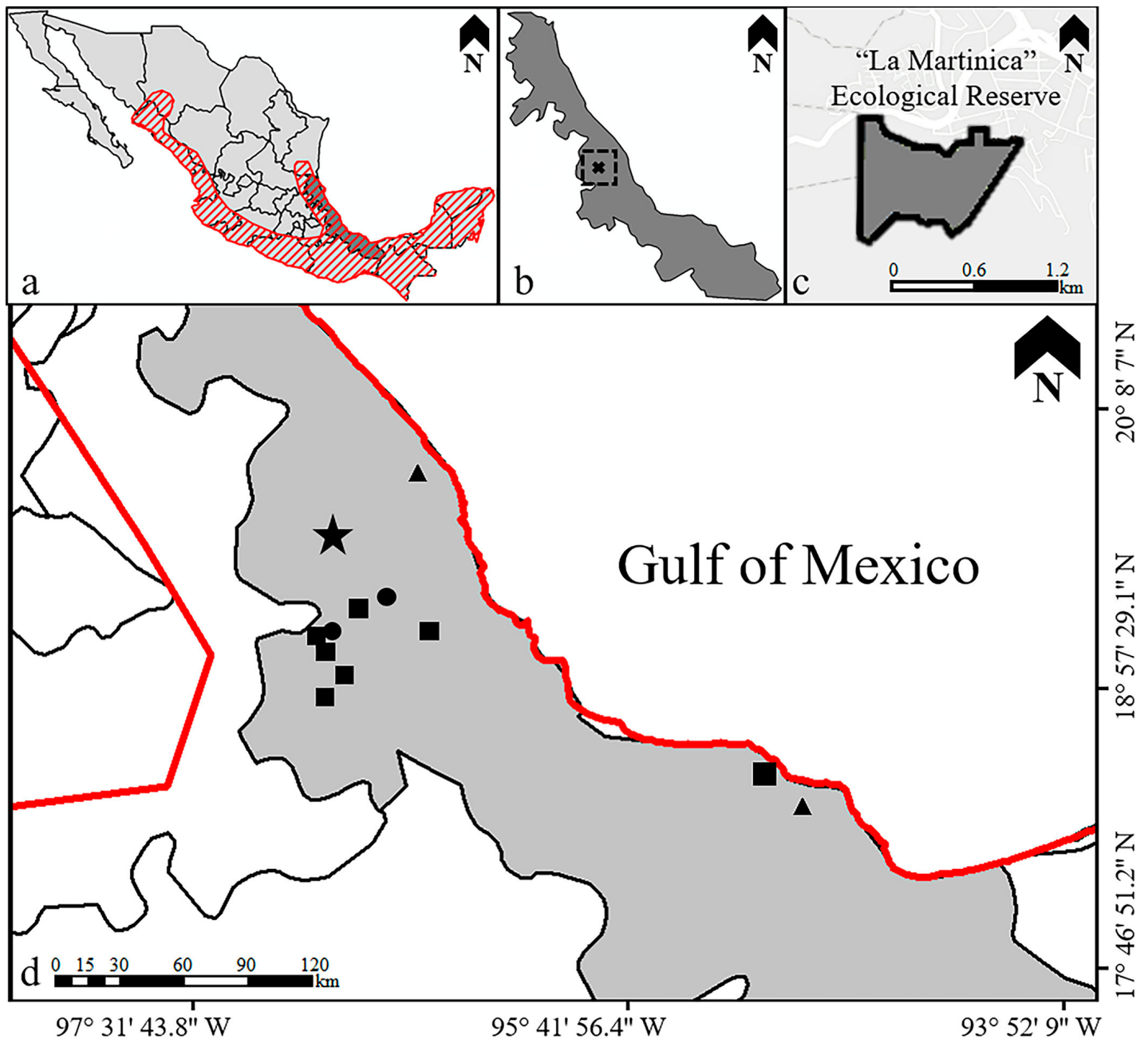


Figure 2. a) Distribution of *Leopardus wiedii* in México. b) Location of the study area in the state of Veracruz. c) Study area, "La Martinica" Ecological Reserve. d) Distribution of the records of *Leopardus wiedii* in the state of Veracruz obtained during XXI Century: ▲ = Sighting, ● = Road-killed specimen, ★ = Photcapture in "La Martinica", ■ = Photographic records.

biological databases consulted were iNaturalist (<https://www.inaturalist.org>) and the Global Biodiversity Information System (GBIF; <https://www.gbif.org>). Only records that provided documentary evidence were included.

After a sampling effort of 2,525 trap-days, over a period of 18 months (of a total of 25 months), 50 different locations of camera stations (terrestrial stations $n = 25$; arboreal stations $n = 25$), and surveyed more than > 95 % of the surface of "La Martinica" (effective sampling area of 0.5 km²) a notable record of *L. wiedii* was obtained in January 02 of 2023, at 03:32 hr (Figure 1). The species was identified by its size, thin shape, long-thick tail, and distinctive thick spotted pattern on its coat (Ávila-Nájera *et al.* 2024) these are specific characteristics of the species, that allow their

differentiation from ocelot (larger and heavier body, big head, small eyes, large spots, slim-short tail; Leyhausen 1990; Ramírez-Barajas *et al.* 2014).

The record was obtained from a terrestrial station, installed in a scrubland with abundant leathery colicwood trees (*Myrsine coriacea*), at an altitude of 1,553 m. Due to the position of the specimen in the photograph, its sex is unknown due to it was not possible to observe genitals.

Form the biological databases consulted, 19 records of *L. wiedii* in the state of Veracruz were found between March 2016 and November 2023 (Table 1; Figure 2; there are no records available between 2000 and 2016); the records correspond to camera trap captures ($n = 14$), roadkill specimens ($n = 2$), and direct observations ($n = 3$). After

compared the location between the records found with the one reported in this work, it was identified that the photo-capture obtained in “La Martinica” is the northernmost record of the species in the state of Veracruz.

Camera traps allows rare or elusive species to be recorded in an ecosystem, in some researches, the sampling effort invested to obtain records is relatively small (Rowcliffe *et al.* 2008), sometimes the capture frequency is related to the abundance and density of the target species in the study location. Researches that points out the presence of *L. wiedii* in localities throughout the species distribution are based upon different type of records: roadkill (Aguilar-López *et al.* 2015), dissected specimens (Tapia-Ramírez *et al.* 2013), or camera trap studies that required different survey efforts to obtain the first record of the species (between 61 and 3,220 trap-

days). Those investigations documented between 1 and 10 individuals at the same locality: 2 records in 61 trap-days (mountain mesophyll forest with fragments of secondary vegetation, Puebla, Mexico; Hernández-Hernández *et al.* 2022); 4 records in 228 trap-days (cloud forest, Morelos, Mexico; Aranda and Valenzuela-Galván 2015); 1 record in 350 trap-days (tropical deciduous forest, Guanajuato, Mexico; Iglesias *et al.* 2008); 4 independent records from to 2 individuals in 796 trap-days (tropical deciduous forest, and surroundings from an oak forest, Nayarit, Mexico; Luja and Zamudio 2019), 5 independent records in 2,970 trap-days (high-altitude, humid and evergreen forests, Huanuco, Peru; Cossios and Ricra 2019); 85 records from 10 individuals in 3,220 trap-days (agricultural and pasture lands, primary and secondary forests, slopes of the Andes, Ecuador; Vanderhoff *et al.* 2011).

Table 1. Records and sightings of *Leopardus wiedii* in Veracruz (Mexico) obtained between 2000 and 2023.

Record type	Date	Locality	Latitude	Longitude	Vegetation	Reference
Camera-trap	March 15, 2016	San Andrés Tuxtla	18° 35' 9" N	95° 7' 20.1" W	Tropical and Subtropical Moist Broadleaf Forests	https://www.inaturalist.org/observations/120574706
	August 27, 2019	Tenampa	19° 16' 43.1" N	96° 50' 25.9" W		https://www.inaturalist.org/observations/39319202
	August 28, 2019	Tenampa	19° 16' 43" N	96° 50' 25.9" W		https://www.inaturalist.org/observations/39319201
	December 31, 2020	Paso de Ovejas	19° 11' 0.3" N	96° 32' 22.6" W	Tropical and Subtropical Dry Broadleaf Forests	https://www.inaturalist.org/observations/67548949
	February 11, 2022	Huatusco	19° 9' 41.3" N	97° 0' 27" W	Tropical and Subtropical Moist Broadleaf Forests	https://www.inaturalist.org/observations/149770482
	February 21, 2022	Huatusco	19° 9' 41.2" N	97° 0' 27" W		https://www.inaturalist.org/observations/149770494
	February 21, 2022	Huatusco	19° 9' 41.2" N	97° 0' 27" W		https://www.inaturalist.org/observations/149770501
	February 25, 2022	Huatusco	19° 9' 41.3" N	97° 0' 27" W		https://www.inaturalist.org/observations/149770503
	September 10, 2022	Huatusco	19° 6' 11.5" N	96° 58' 41.8" W		https://www.inaturalist.org/observations/135852729
	January 02, 2023	Banderilla	19° 35' 12.4" N	96° 57' 8.6" W		This research
	February 14, 2023	Huatusco	19° 9' 53.7" N	97° 0' 29.1" W		https://www.inaturalist.org/observations/149739771
	February 15, 2023	Huatusco	19° 9' 53.7" N	97° 0' 29.1" W		https://www.inaturalist.org/observations/149739772
	February 18, 2023	Huatusco	19° 9' 53.7" N	97° 0' 29.1" W		https://www.inaturalist.org/observations/149739774
	June 03, 2023	Cordoba	18° 54' 36.2" N	96° 58' 38.4" W		https://www.inaturalist.org/observations/176373025
	September 27, 2023	Cordoba	18° 59' 45.3" N	96° 53' 51.1" W		https://www.inaturalist.org/observations/191231073
	April 22, 2021	Apazapan	19° 19' 43.6" N	96° 42' 57.4" W	Tropical and Subtropical Dry Broadleaf Forests	https://www.inaturalist.org/observations/74905091
	January 11, 2022	Sochiapa	19° 11' 13.9" N	96° 57' 13.6" W	Tropical and Subtropical Moist Broadleaf Forests	https://www.inaturalist.org/observations/104775953
	October 31, 2016	Catemaco	18° 26' 17.7" N	94° 57' 44.3" W	Tropical and Subtropical Moist Broadleaf Forests	http://conabio.inaturalist.org/observations/4510229
Direct observations	October 31, 2016	Ejido Adolfo López Mateos, Catemaco	18° 26' 14.4" N	94° 57' 53.5" W		http://conabio.inaturalist.org/observations/4515007
	November 28, 2016	Vega de Alatorre	19° 50' 53.6" N	96° 35' 5.7" W		https://www.inaturalist.org/observations/34068188

Although the margay is included in the list of species present in the state of Veracruz (González-Christen and Delfín-Alfonso 2016), the survey carried out in “La Martinica” required a sampling effort of 2,525 trap-days to obtain a single record; the trap-days from arboreal stations were included because *L. wiedii* is physiologically adapted to display arboreal activity (de Oliveira 1998; Domínguez-Castellanos and Ceballos 2005), for that reason is considered the most arboreal among the New World felid (Hodge 2014).

The record reported here is considered occasional, the entire survey lasted over 25 uninterrupted months in which the terrestrial mammal community present in the area was monitored, after the record of margay in the eighteenth month no additional traces (corpses, feces, footprints, and scratching posts) were documented. Therefore the existence of resident populations of *L. wiedii* within “La Martinica” is ruled out due to: 1) the survey in the region indicates a reduced abundance and richness of mammals, composed by of carnivores: *Bassariscus astutus*, *Canis familiaris*, *Felis catus*, *Neogale frenata*, *Procyon lotor*, *Urocyon cinereoargenteus*; cingulates: *Dasyus novemcinctus*; didelphids: *Didelphis* spp, *Marmosa mexicana*; lagomorphs: *Sylvilagus floridanus*; and rodents: *Peromyscus* spp, *Sciurus aureogaster*; so the margay have several competitors and low availability of preys, 2) *L. wiedii* has a preference for localities whose native vegetation has a dense cover (Morales-Delgado et al. 2021), this attribute does not occurs in “La Martinica”, the Reserve is fragmented, partially surrounded by the town of “Banderilla”, and the extraction of biodiversity for economic (obtain raw materials, or derivatives that are marketed), or subsistence purposes (edibles, or elements for medicinal use) is permanent. Therefore, it is speculated that the specimen was photographed during its dispersion process to a site with more favorable conditions.

The IUCN Red List of Threatened Species (de Oliveira et al. 2015) indicates that wild populations of *L. wiedii* are declining due to human-induced conversion of native forest habitats to agriculture, pasture, and urban development (de Oliveira et al. 2015). Although the state of Veracruz occurs within the species’ potential range (Morales-Delgado et al. 2021), availability of suitability habitat is low (<0.69) across most of the state. The status of *L. pardalis* populations occurring in the state of Veracruz is currently unknown.

The 19 records of *L. wiedii* in the state of Veracruz during the XXI Century corresponds to researches, opportunistic sightings, and reports of roadkill specimens. The photo capture from “La Martinica” along with the record reported for Vega de Alatorre (46 km away) in 2016 (direct observation, November 28, 2016; Table 1), are the northernmost records of the species within the state of Veracruz. It is necessary to design and implement studies focused on *L. wiedii* to generate ecological knowledge about the species that can be used for conservation strategies for the species and its habitat.

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