

Roaming among humans: noteworthy records of jaguar (*Panthera onca*) close to human settlements in the Paraguayan Humid Chaco

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Abstract

Roaming among humans: noteworthy records of jaguar (Panthera onca) close to human settlements in the Paraguayan Humid Chaco. Jaguars (*Panthera onca* Linnaeus, 1758) have been extirpated from nearly 55% of their original range in America and from almost 24% in Paraguay. Here we present evidence of the presence of jaguar close to the most populated areas of Paraguay, in a human–dominated landscape in the Humid Chaco forests, highlighting how without other pressures, jaguars can inhabit densely populated areas and potentially disperse between established populations.

Key words: Camera trap, Deforestation, Livestock, Savanna, Wetland, Paraguayan Humid Chaco

Resumen

Deambulando entre seres humanos: registros notables sobre el jaguar (Panthera onca) en la proximidad de asentamientos humanos en el Chaco Húmedo de Paraguay. Los jaguares (*Panthera onca* Linnaeus, 1758) han sido extirpados de casi el 55% de su área de distribución original en América y de cerca del 24% del territorio de Paraguay. En esta comunicación presentamos evidencias de la presencia del jaguar muy cerca de las áreas más pobladas de Paraguay, en un paisaje dominado por la presencia humana en los bosques del Chaco Húmedo, resaltando como, sin otras presiones, los jaguares pueden habitar áreas densamente pobladas por humanos y potencialmente dispersarse entre poblaciones silvestres establecidas.

Palabras clave: Cámara trampa, Deforestación, Ganadería, Sabana, Humedal, Chaco Húmedo de Paraguay

Resum

Deambulant entre éssers humans: registres notables sobre el jaguar (Panthera onca) prop d'assentaments humans al Chaco Humit del Paraguai. Els jaguares (*Panthera onca* Linnaeus, 1758) han estat extirpats de gairebé el 55% de la seva àrea de distribució original a Amèrica i de prop del 24% del territori del Paraguai. En aquesta comunicació presentem evidències de la presència del jaguar molt a prop de les àrees més poblades del Paraguai, en un paisatge dominat per la presència humana als boscos del Chaco Humit, la qual cosa

fa palès que, sense altres pressions, els jaguars poden habitar àrees densament poblades per humans i dispersar-se potencialment entre poblacions silvestres establertes.

Paraules clau: Càmera parany, Desforestació, Ramaderia, Sabana, Aiguamoll, Chaco Humit del Paraguai

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Introduction

The jaguar (*Panthera onca*) is the largest wild felid in the Americas, found from the south-western United States to northern Argentina (de la Torre et al., 2017). The species has disappeared from over 55% of its historical range, and recent assessments of its regional and continental conservation status have concluded that populations continue to decline in most of its current range (de la Torre et al., 2017; Quigley et al., 2017). Originally, the jaguar was present right throughout Paraguay, but it has now been extirpated from a large area of the country (Giordano et al., 2017). Paraguay is a landlocked country in the center of South America with a surface area of 406,752 km². The country has five natural regions: the Dry Chaco, the Humid Chaco, the Alto Paraná Atlantic Forest, the Cerrado, and the Pantanal (Olson et al., 2001). The two most prominent regions are the Eastern and the Western Regions, the latter also known as the Chaco. The two are very distinct natural regions, both physically and biologically, separated by the Paraguay River. The Chaco is the portion of Paraguay that lies west of the Paraguay River. It occupies 60% of the national territory, but it has the lowest population density (Mereles et al., 2013; Mereles and Rodas, 2014; Gill et al., 2020; Mereles et al., 2020). The capital of Paraguay is Asunción, and together with its surrounding areas it is the most densely populated area of the country, located on the other side of the Paraguay River in the Eastern Region.

The forests of the Eastern Region of Paraguay occupy the ecoregion of the Alto Paraná Atlantic Forest (Ribeiro et al., 2009; Avila Torres et al., 2018). They have decreased dramatically in size since the 1960s, mostly due to the rapid expansion of agriculture. The forests of the Western Region or Chaco are also currently being converted into pastures for cattle or agricultural purposes. Annual deforestation rates throughout the Gran Chaco are estimated to exceed the average rate of loss of all forests globally since the mid–20th century (Foley et al., 2005). Between 1985 and 2013, 20% of all the Chaco Forest was replaced by croplands or grazing lands (Caldas et al., 2013; Hansen et al., 2013; Vallejos et al., 2015; Baumann et al., 2017). The Chaco is not only affected by an intense process of deforestation but also from extensive loss of natural grasslands, both on higher lands and wetlands, with a rate of disappearance even higher than that of the forests (Bucher, 2016; Gill et al., 2020).

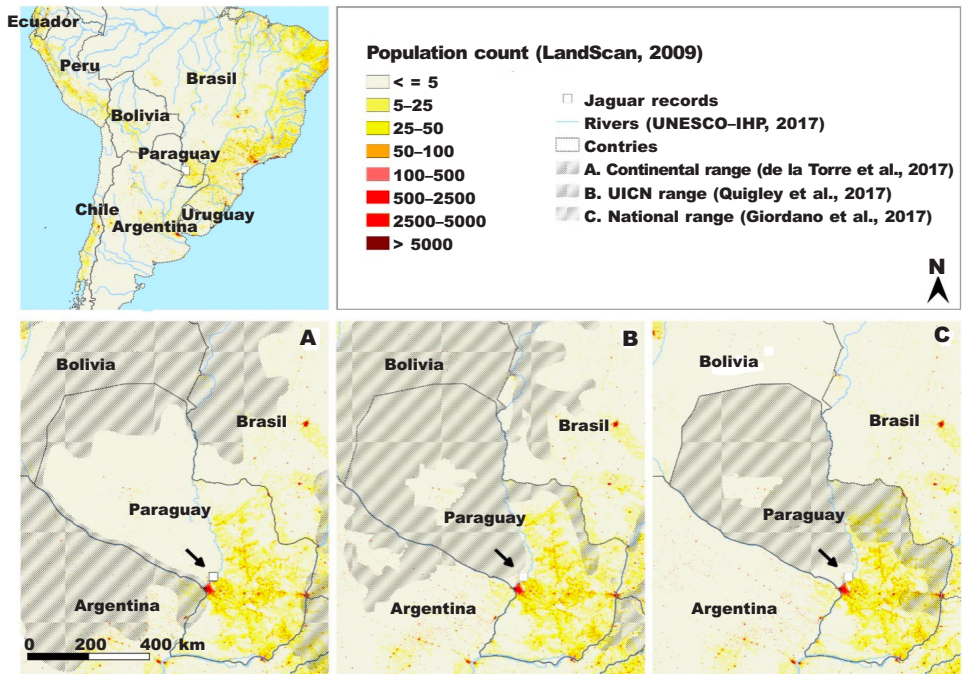


Fig. 1. Location of the new records of jaguars in the Humid Chaco of Paraguay in contrast with the known distribution for the species according to: A, de la Torre et al. (2017); B, Quigley et al. (2017); and C, Giordano et al. (2017).

Fig. 1. Localización de los nuevos registros de jaguares en el Chaco Húmedo de Paraguay en contraste con la distribución conocida de la especie según: A, de la Torre et al. (2017); B, Quigley et al. (2017); C, Giordano et al. (2017).

Material and methods

The study area is located in the Paraguayan Humid Chaco, where the landscape is composed of a mosaic of natural grasslands, palm groves, wetlands, and islands of dense forest. Jaguar records were obtained close to the cities of Villa Hayes (30 km) and Benjamin Aceval (20 km), both of which are among the most populated in the Paraguayan Chaco (Gill et al., 2020). The city of Asunción is located only 50 km away (in a straight line) but separated by the Paraguay River (fig. 1).

Results and discussion

Here we present rural records of jaguar sightings from a human-dominated landscape close to densely populated human settlements. These sightings likely fall outside the currently estimated or known range for the species according to national (Giordano et al., 2017) and international (de la Torre et al., 2017; Quigley et al., 2017) reports. The recorded sightings

Table 1. New records for jaguar in the Humid Chaco of Paraguay, including location, date and vegetation type.

Table 1. Nuevos registros de jaguares en el Chaco Húmedo de Paraguay que incluyen la localización, la fecha y la vegetación tipo del lugar.

Record	Photo	Geographic		Vegetation type
		coordinates	Date	
Jaguar footprint cast	Fig. 2A	24°57'52" S 57°22'05" W	2016	Dense subtropical forest
Predation on calves	Fig. 2B	24°57'47" S 57°22'02" W	2016	Natural grasslands
Jaguar tree-marks	Fig. 2C	24°57'19" S 57°19'54" W	31/03/2020	Riparian forest
Jaguar tracks	Fig. 2D	24°57'40" S 57°21'32" W	28/05/2020	Natural grasslands
Jaguar tracks	Fig. 2E	24°57'30" S 57°22'19" W	18/07/2020	Dense subtropical forest
Jaguar tracks	Fig. 2F	24°57'48" S 57°21'40" W	13/08/2020	Riparian forest
Jaguar sighting	–	24°57'44" S 57°21'51" W	10/2020	Dense mesoxerophytic forest
Jaguar photo	Fig. 2G	24°57'44" S 57°21'41" W	29/11/2020	Riparian forest

are located 32 km northeast, 20 km southeast and 40 km south of the previously considered limits of the species in its southern range according to de la Torre et al. (2017), Quigley et al. (2017) and Giordano et al. (2017), respectively (fig. 1A, 1B, 1C). The closest records to this locality, available through the GBIF.org (GBIF, 2021) are at least 110 km away.

The presence of the jaguar in the area had been suspected in previous years due to the size of tracks found and alleged predation events on calves that showed very similar signs of attacks by jaguars in other locations (table 1; fig. 2A, 2B). However, the species was not recorded during camera trapping efforts conducted at the study site from late 2016 to mid-2019 (Caballero-Gini et al., 2020; Laino et al., 2020). Months before the species was recorded by camera trap here, tracks and a tree where jaguars are said to sharpen their nails were also recorded (table 1; fig. 2C–2F). In addition, a worker on one of the cattle ranches in the area reported seeing a jaguar on a field trip in October 2020 (table 1). A photograph of a jaguar walking along a river bank was taken by a camera trap on 29/11/2020 at 22:35 h, thus confirming these previous alleged records of the species, (table 1; fig. 2G).

The jaguar is categorized as Near Threatened by the IUCN Red List of Threatened Species (Quigley et al., 2017). However, at the austral limit of its distribution the species is considered Critically Endangered in Argentina (Paviolo et al., 2019) and Paraguay (Giordano et al., 2017), and Vulnerable in Brazil (Gonçalves Morato et al., 2018). Jaguar pop-

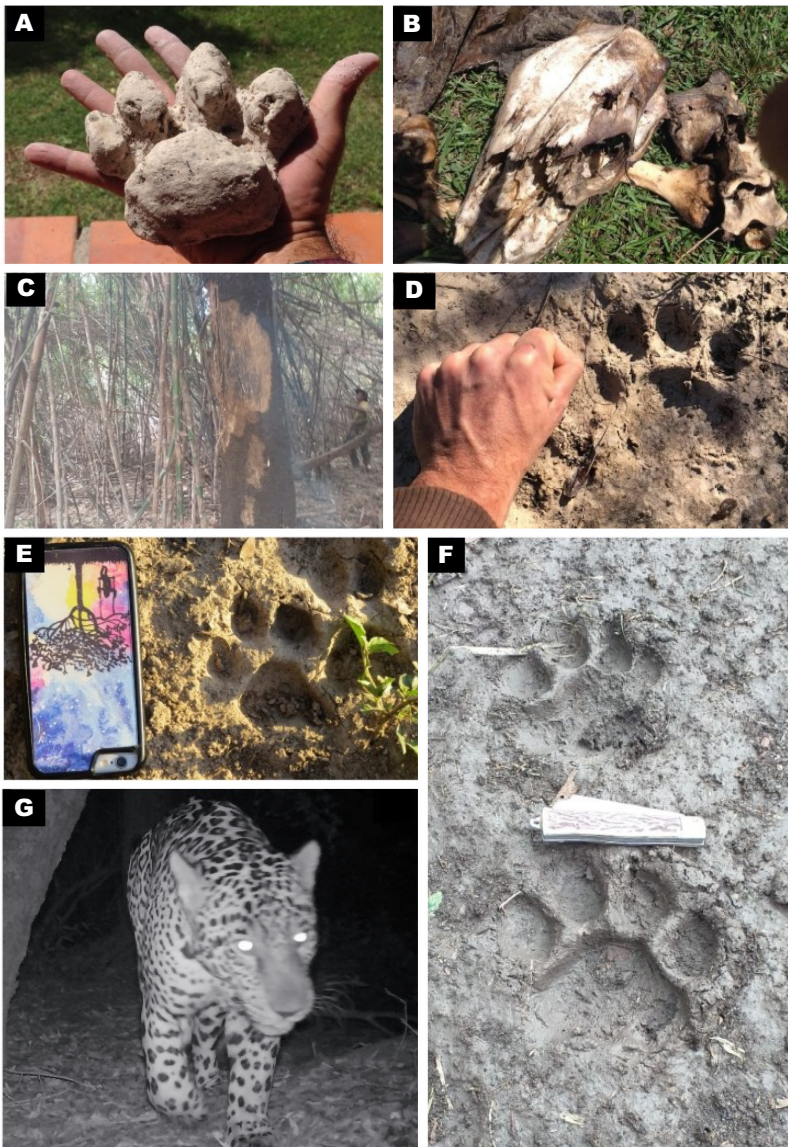


Fig. 2. Evidence of jaguars in the Humid Chaco of Paraguay: A, jaguar footprint cast found on one of the roads of the cattle ranch (courtesy of K. Musalem); B, skull of a calf allegedly attacked by a jaguar (courtesy of K. Musalem); C, jaguar tree–marks at the same locality (courtesy of R. Acosta); D, jaguar footprint found on a road in the cattle ranch (courtesy of L. Guanes); E, jaguar footprint found on a road in the middle of the forest (courtesy of P. Roche); F, jaguar footprint found beside the river (courtesy of R. Acosta); G, camera trap photo of a jaguar walking along a river bank in the Humid Chaco. (Table 1 gives details of each record).

Fig. 2. Evidencias de jaguares en el Chaco Húmedo de Paraguay: A, molde de una huella de jaguar encontrada en uno de los caminos del rancho (cortesía de K. Musalem); B, cráneo de ternero supuestamente atacado por un a jaguar (cortesía de K. Musalem); C, marcas producidas por un jaguar en un árbol en la misma localidad (cortesía de R. Acosta); D, huella de jaguar encontrada en uno de los caminos del rancho (cortesía de L. Guanes); E, huella de jaguar encontrada en un camino en medio del bosque (cortesía de P. Roche); F, huella de jaguar encontrada cerca del río (cortesía de R. Acosta); G, fotografía de un jaguar caminando por la orilla de un río en el Chaco Húmedo tomada por una cámara trampa. (Los detalles de cada registro están disponibles en la tabla 1).

ulations in the Chaco Region are low-density and highly threatened by livestock ranching and persecution (Quigley et al., 2017; McBride and Thompson, 2018). The species is also potentially threatened in the region by the widespread, accelerated deforestation rates in the Chaco Forest and the consequent genetic effects on populations, such as inbreeding and isolation. Such landscape transformations will also likely have severe effects on potential prey species, especially herbivores, due to their own population reductions related to habitat fragmentation and decreased diversity of plants available (Mereles and Rodas, 2014; Romero-Muñoz et al., 2019).

The jaguar's dispersal is limited by anthropogenic factors. For example, for the Eastern Region of Paraguay, the few remaining forests are isolated and surrounded by crops, generating a landscape with a matrix that prevents genetic flow (Haag et al., 2010; Giordano et al., 2017). Thus, maintaining or restoring functional corridors and consolidating new habitat areas that further promote jaguar conservation beyond the boundaries of the current protected areas system (Srbek-Araujo et al., 2018; Menchaca et al., 2019) seems warranted. Because the Humid Chaco connects the Dry Chaco and the Pantanal with the Alto Paraná Atlantic Forest and Cerrado (Avila Torres et al., 2018), conservation measures in these habitats will ensure jaguar connectivity (Rabinowitz and Zeller, 2010; De Angelo et al., 2013; Olsoy et al., 2016). Despite its high biodiversity, the Humid Chaco clearly lacks sufficient protected areas (Caballero-Gini et al., 2020; Cartes and Yanosky, 2020).

In areas that are threatened by high human density and severe risk of habitat loss, landscape management policies should procure not only to conserve the jaguar habitat but also to ensure the wellbeing of human communities that coexist with this iconic species (de la Torre et al., 2017; Koprowski et al., 2019). The large home ranges required by jaguars in Western Paraguay and the low proportion of land under protection in the region, highlight the importance and potential role that private ranchlands contribute to the long-term conservation goals of this and multiple other species (McBride and Thompson, 2018).

Our contribution highlights how jaguars are able to move and inhabit areas in the Humid Chaco close to densely human populated areas and disperse large distances through human-dominated landscapes from the closest known breeding populations. It is likely that without human pressures (such as poaching and retaliatory killing) jaguars could move through human-dominated landscapes and probably live in proximity to people. Controlling such pressures and allowing, maintaining or recovering movement and habitats could open important conservation opportunities for jaguar dispersal through heavily transformed areas.

The Humid Chaco ecosystem in Paraguay is currently at high risk of collapse due to the intensification of agriculture and livestock production and to a lesser extent due to the expansion of urban areas. This not only affects the populations of jaguars, but also one of the world's most imperiled ecosystems. Strategies that promote effective conservation of this ecoregion, including tailor-made incentives, are therefore critically needed and will contribute to the long-term maintenance of its biodiversity.

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