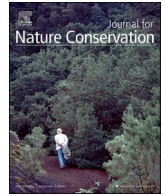




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## The last stronghold of Muñoa's Pampas cat (*Leopardus munoai*) in Argentina?

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## ABSTRACT

The Muñoa's Pampas cat (*Leopardus munoai*) is a relatively understudied species restricted to open savannas and grasslands of Southern Brazil, Uruguay and NE Argentina, that has been recently split from the broader "Pampas cat" species complex. Only three documented records of the species have been published since the year 2000 for the Argentine portion of its distribution, a situation that led to speculations regarding its conservation status in Argentina. We conducted an intensive camera-trap survey (2,067 camera-trapping stations and 15,560 camera-trapping days) to assess the presence of the Muñoa's Pampas cat in an area of 275.3 km<sup>2</sup> within the Iberá National Park and the adjacent Iberá National Reserve, Corrientes province, Argentina. Four records of Muñoa's Pampas cat were obtained, representing at least two adults and one young individual. Only one camera-trapping record of this species had been previously obtained in Argentina, during a survey carried out in 2009 in the same study area, despite an important camera-trapping effort in the Corrientes province. All camera-trap records of Muñoa's Pampas cat in Argentina are concentrated in areas of temporally flooded grasslands locally known as "Malezales", suggesting that this habitat type is critically important for the conservation of this rare felid. The Iberá National Park and the adjacent Iberá National Reserve provide the adequate framework for the conservation of an important piece of habitat for Muñoa's Pampas cat and constitute a stronghold for the species in Argentina.

The Muñoa's or Uruguayan Pampas cat (*Leopardus munoai*), recently proposed as *Leopardus fasciatus* by Martínez-Lanfranco and González (2022), is a small Neotropical felid (3–4 kg) recently split from the broader "Pampas cat" species complex historically recognized as a single species, *Leopardus colocola* (Nascimento et al., 2021). This species complex occupies a wide variety of habitat types that, excluding rain forests, range from dry forests, scrublands, grasslands, swampy wetlands, to deserts and rocky outcrops in the high Andes (Lucherini et al., 2016). However, *L. munoai* has been exclusively reported in different types of open savannas and grasslands in Southern Brazil, Uruguay and NE Argentina (Ximénez, 1961; García-Perea, 1994; Tirelli et al., 2021). The lack of knowledge of the most essential aspects of the species'

biology precludes an assessment of its conservation status, although recent population estimates based on spatial distribution models and demographic assumptions suggested that Muñoa's Pampas cat should be categorized as Endangered or Critically Endangered (Tirelli et al., 2021).

The westernmost sector of the species distribution (i.e., the Corrientes province in Argentina) is included within two ecoregions: the Southern Cone Mesopotamian Savannas and the Iberá Wetlands. These ecoregions are characterized by a diverse array of habitats that encompass extensive natural grassland and savanna communities, including open grasslands, temporarily flooded grasslands, wetlands, and isolated woodlands and gallery forests (Burkart et al., 1999). Tirelli et al. (2021) showed that the westernmost sector of the species'

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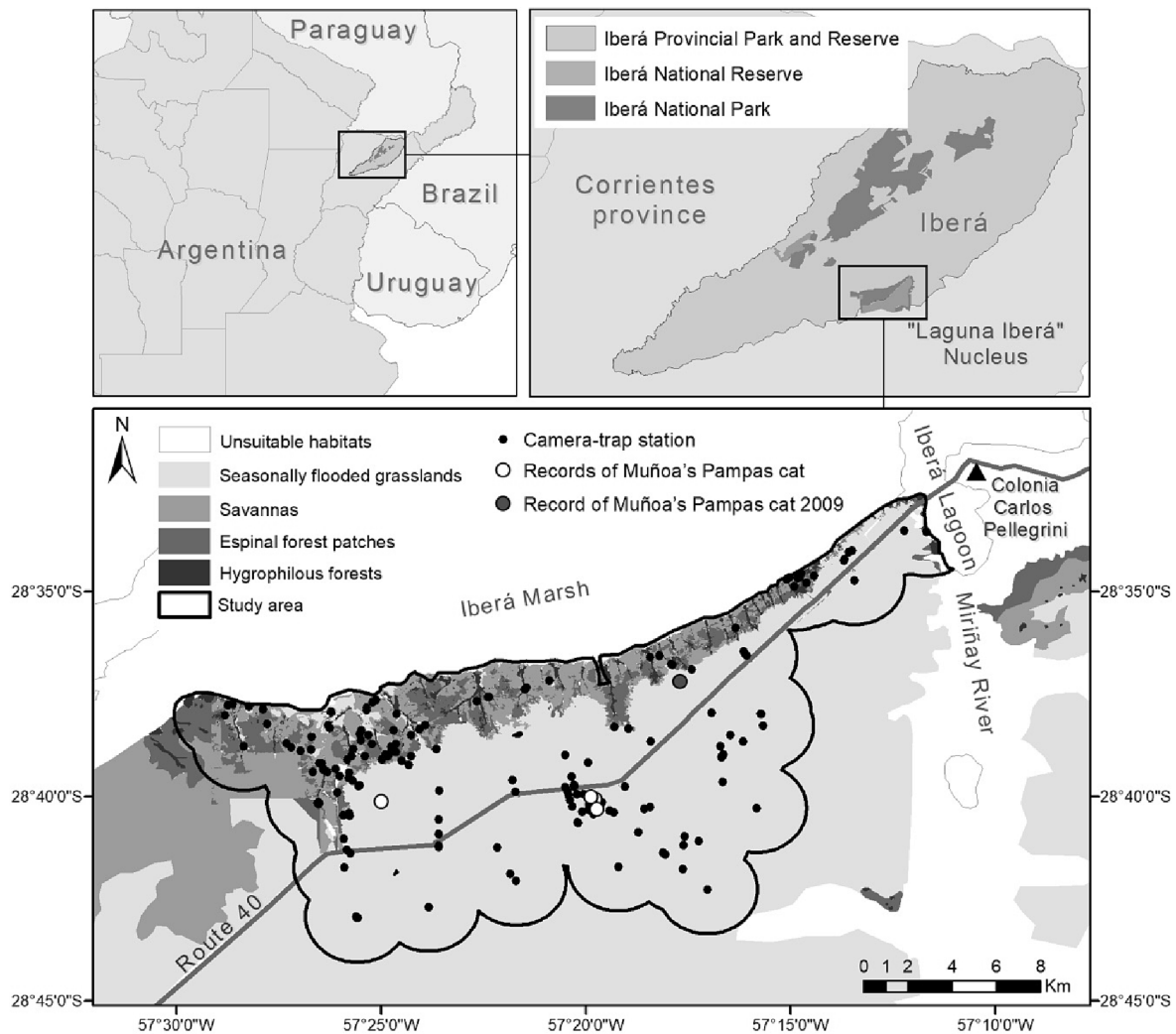


Fig. 1. Study area and location of camera-trap stations within the Iberá National Park and the Iberá National Reserve, Corrientes province, Northeastern Argentina, 2019–2023.

distribution has medium-to-very low habitat suitability for this felid and is almost not connected to the core area of the species distribution, which occurs in central Uruguay and southern Brazil. However, these results may reflect that niche modeling was performed with presence records coming mostly from Uruguay and Brazil, where habitat conditions are likely different from those that occur in Corrientes, underestimating habitat suitability for this species in Argentina. In spite of this, the paucity of records of Muñoa's Pampas cat in Argentina is remarkable, since only three documented reports have been published since the year 2000: two road killed individuals, one found in 2007 (Chebez et al., 2008) and another in 2008 (Soljan et al., 2010), and a skull found in 2011 (Pasian et al., 2015). The absence of new evidence during the last decade led to speculations regarding the current conservation status of this felid in Argentina (Lucherini et al., 2019).

Between 12 July 2019 and 4 February 2023, we conducted an intensive camera-trap survey to assess the presence of Muñoa's Pampas cat in the Iberá Wetlands ecoregion, Corrientes province, Argentina. The Iberá is one of the largest (c. 14,000 km<sup>2</sup>) wetlands in South America, comprising the huge Iberá marsh and the terrestrial communities that surrounds it (Neiff & Poi de Neiff, 2005). The study area is located southwest of the town of Colonia Carlos Pellegrini (28°32'S, 57°10'W), and encompasses sectors of the recently created Iberá National Park (the "Laguna Iberá" Nucleus) and the Iberá National Reserve (Fig. 1). Field work implied the deployment of 2,067 non-baited camera-trapping

stations, each comprising one digital camera trap (Browning Strike Force, Browning Strike Force Max, Stealth Cam LLC, Reconyx RC55, Reconyx Hyperfire Semi-Covert IR, Reconyx Hyperfire 2, or Bushnell Trophy Cam) attached to a steel or wooden stake or to the base of a tree at a height of c. 40–55 cm above ground level. Stations were deployed in all habitat types and at any site considered potentially suitable to detect wild felids, for which a criterium of spatial independence based on the distance between stations was not taken into consideration for the sampling design. As a result, the minimum distance between closest stations varied from 40 m to 2,814 m (mean = 476 m). Stations were active, on average, for 7.53 consecutive days (range = 1–73 days), and were situated on potential travelling routes for carnivores (e.g., trails, dirt roads, stream beds) or at random places, covering a total study area of 275.3 km<sup>2</sup> (obtained by applying a buffer width of 2 km to each camera trap station and excluding unsuitable habitats like permanent water bodies; Fig. 1). All units were active 24 h day<sup>-1</sup> and set to take a 10-sec video or three pictures after being triggered. Camera-trap stations were located in four habitat types: seasonally flooded grasslands dominated by *Andropogon lateralis*, locally known as "Malezales" (N = 889 stations); savannas dominated by the caranday palm (*Copernicia alba*; N = 409); small forest patches typical of the Espinal ecoregion, dominated by the legume trees *Neltuma affinis* and *Vachellia caven*, (N = 702); and hygrophilous forests along streams, composed by several tree species typical of the Atlantic Forest ecoregion, that form a continuous canopy

**Table 1**

Proportion cover of each habitat type and of camera-trapping sampling effort (# stations) per habitat type within the surveyed area in the Iberá National Park and the Iberá National Reserve, Corrientes province, Northeastern Argentina, 2019–2023.

Habitat type	Cover	Sampling effort
Seasonally flooded grasslands (“Malezales”)	0.76	0.43
Savannas	0.13	0.20
Espinal forests	0.09	0.34
Hygrophilous forests	0.02	0.03

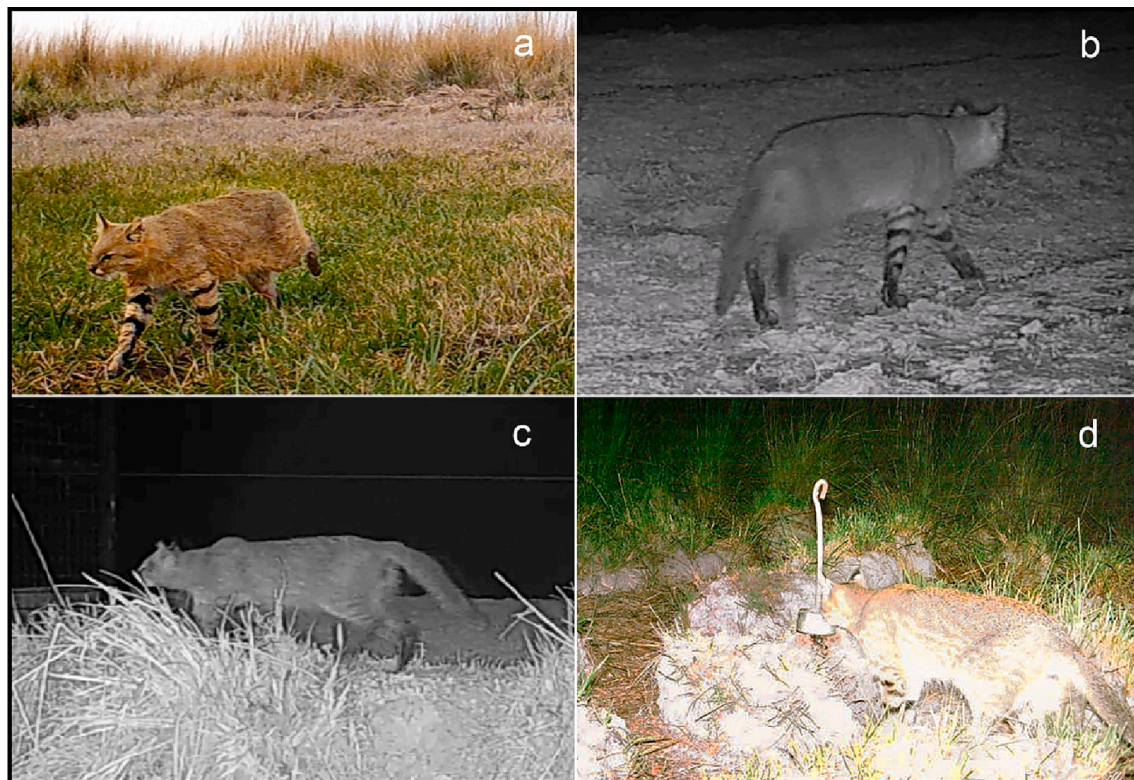
that reaches 15–20 m in height ( $N = 67$ ). These four habitat types were neither evenly distributed within the study area nor were they sampled proportionally (Table 1).

After an effort of 15,560 camera-trapping days, four records of Muñoa’s Pampas cat were obtained on video at four different camera trap stations (Fig. 1). The first record was taken on July 27, 2020, at 8.59 h AM, representing an adult individual of unknown sex (Fig. 2a) rapidly crossing a stream bed within a Malezal (28.668916°S, 57.416555°W). The second record was obtained on July 4, 2022, at 8.24 h PM, corresponding to an adult male moving through an occasionally used dirt road crossing the Malezal, at a camera station 8.3 km away from the first record (28.667193°S, 57.331402°W). The third record was registered on September 30, 2022, at 4.57 h AM in the same occasionally used dirt road but 202 m southeast of the previous finding (28.668043°S, 57.329588°W). These last two records (Fig. 2b and 2c) probably represent the same adult male, based on their spatial and temporal proximity and physical characteristics of the individual. Finally, a small-sized Muñoa’s Pampas cat (probably a juvenile) of unknown sex was recorded on October 31, 2022, at 3.15 h PM, trotting across the Malezal (28.672030°S, 57.329003°W; see Supplementary material). Considering the number of stations with and without records of Muñoa’s Pampas cat in Malezales vs. all other habitat types taken

together, it is highly unlikely that the few stations with records for the species were all located in Malezales (Fisher’s Exact Test,  $p = 0.015$ ). This suggests a higher probability of recording this felid in Malezales than in other habitat types within the studied landscape.

To our knowledge, these records provide the only confirmation in more than a decade that the Muñoa’s Pampas cat still persists in Argentina. Other recent (2009–2022) camera-trap studies conducted in different landscapes of the Corrientes province, that together sum 459 stations and 20,890 camera-trap days, have failed to detect this felid (e. g., Browne et al., 2023; Chatellenaz et al., 2018; Iezzi et al., 2021; Ávila, 2023; Castro-Claros, 2015; S. Cirignoli, unpublished data; Q. Gómez et al., unpublished data). Interestingly, only one previous camera-trapping record of a Muñoa’s Pampas cat (Fig. 2d) had been obtained in Argentina (on January 11, 2009, at 9:35 PM), during a previous survey (50 stations and 3,050 camera-trap days) carried out in an area overlapping our study area by two of the authors (M.S. Di Bitetti and Y.E. Di Blanco, unpublished data; Fig. 2d). These records emphasize the conservation significance of the terrestrial ecosystems within the Iberá wetland and, particularly, of our sampling area, for this virtually unknown species. They also emphasize the importance of further monitoring and, if possible, studies on the ecology, demography, and population trends of the species in this area. The low density of the species may preclude these studies, but the record of what appears to be a juvenile is encouraging and suggests that, even though small, this population may persist if adequate conditions and protective measures continue in the area.

All camera-trap records of Muñoa’s Pampas cat in Argentina are concentrated in areas of temporally flooded grasslands locally known as Malezales, and dominated by native grasses, mainly *A. lateralis*. This suggests that well preserved Malezales may be critically important for the conservation of this rare felid in Argentina. The fact that this area with records of Muñoa’s Pampas cat has recently become part of the Iberá National Park provides the adequate framework for the conservation of an important piece of habitat for this species. This is



**Fig. 2.** Photographic records of Muñoa’s Pampas cat obtained within the Iberá National Park and the Iberá National Reserve, Corrientes province, Argentina: (a) Adult of unknown sex, July 27, 2020; (b) Adult male, July 4, 2022; (c) Adult male, September 30, 2022; (d) Adult of unknown sex, January 11, 2009.



remarkable given Malezales beyond this area are not currently protected and show the long-term effects of extensive cattle management (with the associated presence of dogs and the use of fire), cropland expansion (e.g., rice, soybean) and, more recently, an accelerated land conversion to commercial forest plantations (Viglizzo et al., 2006; Kurtz et al., 2018; Pereira et al., 2023). Populations of several other rare or endangered native species have recently rebounded in the Iberá region after the creation of protected areas, particularly species dependent on native grasslands, such as the marsh deer (*Blastocerus dichotomus*), the maned wolf (*Chrysocyon brachyurus*), and the strange-tailed tyrant (*Alectrurus risora*), which are extremely rare in areas under traditional cattle management (Di Bitetti et al., 2020; Browne et al., 2023). Since less than 1% of the high-suitability landscape for the Muñoa's Pampas cat is currently protected across its entire distribution range (Tirelli et al., 2021), the area encompassed by the "Laguna Iberá" Nucleus of the Iberá National Park and the adjacent Iberá National Reserve constitutes a stronghold for the species in Argentina. Conservation efforts should be prioritized in this sector to save one of the possibly most endangered mammals of Argentina.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jnc.2023.126449>.

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