Small wild cats in the uruguayan pampa biome: records from Valle del Lunarejo

Pequenos felinos selvagens no bioma da Pampa uruguaia: registros do Vale do Lunarejo

Pequeños felinos salvajes en el bioma de la pampa uruguaya: registros del Valle del Lunarejo

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ABSTRACT
The Pampa biome harbors a unique diversity of small wild cats, whose ecological knowledge and conservation status remain poorly documented in Uruguay. This study reports the occurrence and relative frequency of three Leopardus species, *L. geoffroyi*, *L. wiedii*, and *L. munoai*, within the Valle del Lunarejo Protected Landscape. From 2021 to 2023, a network of camera traps was deployed, totaling 1,877 camera-trap nights. Leopardus wiedii was the most frequently recorded species, followed by *L. geoffroyi* and *L. munoai*, the latter with a single record. These results update the known distribution of these species in northern Uruguay and reinforce the importance of Valle del Lunarejo as a priority refuge for their conservation.

Keywords: *Leopardus munoai*, *Leopardus wiedii*, *Leopardus geoffroyi*, camera traps, Uruguay conservation.

RESUMO
O bioma da Pampa abriga uma diversidade única de pequenos felinos selvagens, cujo conhecimento ecológico e estado de conservação continuam pouco documentados no Uruguai. Este estudo informa sobre a presença e a frequência relativa de três espécies de Leopardus, L. geoffroyi, L. wiedii e L. munoai, dentro da Paisagem Protegida do Vale do Lunarejo. Entre 2021 e 2023, foi instalada uma

rede de câmeras armadilha, com um total de 1877 noites de captura. Leopardus wiedii foi a espécie registrada com maior frequência, seguida por L. geoffroyi e L. munoai, esta última com um único registro. Esses resultados atualizam a distribuição conhecida dessas espécies no norte do Uruguai e reforçam a importância do Vale do Lunarejo como refúgio prioritário para sua conservação.

Palavras-chave: Leopardus munoai, Leopardus wiedii, Leopardus geoffroyi, Câmeras armadilha, Conservação no Uruguai.

RESUMEN
El bioma de la Pampa alberga una diversidad única de pequeños felinos silvestres, cuyo conocimiento ecológico y estado de conservación siguen estando poco documentados en Uruguay. Este estudio informa sobre la presencia y la frecuencia relativa de tres especies de Leopardus, L. geoffroyi, L. wiedii y L. munoai, dentro del Paisaje Protegido del Valle del Lunarejo. Entre 2021 y 2023, se instaló una red de cámaras trampa, con un total de 1877 noches de captura. Leopardus wiedii fue la especie registrada con mayor frecuencia, seguida de L. geoffroyi y L. munoai, esta última con un solo registro. Estos resultados actualizan la distribución conocida de estas especies en el norte de Uruguay y refuerzan la importancia del Valle del Lunarejo como refugio prioritario para su conservación.

Palabras clave: Leopardus munoai, Leopardus wiedii, Leopardus geoffroyi, Cámaras trampa, Conservación en Uruguay.

1 INTRODUCTION

The Pampa biome, covering regions of Uruguay, southern Brazil, and northeastern Argentina, is one of the most threatened ecosystems in South America, primarily affected by agricultural expansion, afforestation with exotic species, and habitat fragmentation (Overbeck et al., 2007). In Uruguay, four small wild cat species are currently recorded, three of which, the Pampas cat (*Leopardus munoai*), Geoffroy's cat (*Leopardus geoffroyi*), and margay (*Leopardus wiedii*), inhabit the Valle del Lunarejo.

These felids play a key ecological role as predators of small vertebrates in grasslands, forests, and hill regions. However, important knowledge gaps remain regarding their distribution, abundance, and ecology, especially in northern Uruguay. Recent studies have begun addressing this gap (Turcatti, 2023a, 2023b), providing valuable data on the mammal community and habitat use by mesocarnivores in Valle del Lunarejo.

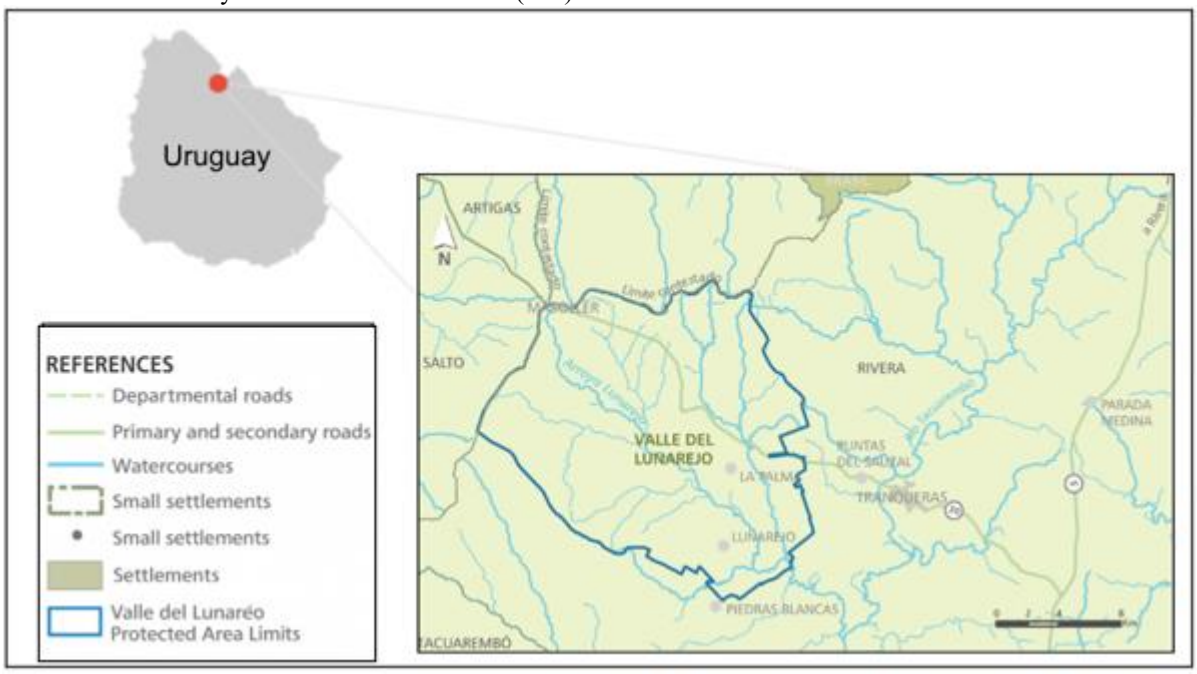
This study aims to characterize the presence and relative frequency of small wild cats in this representative area of the Pampa biome through systematic camera trap monitoring. This information is essential for evaluating their conservation status and guiding management actions within Uruguay's National System of Protected Areas (SNAP).

2 MATERIALS AND METHODS

Study Area

This study was conducted in the Valle del Lunarejo Protected Landscape, located in Rivera Department, Uruguay. This SNAP unit covers approximately 31,500 ha and features a heterogeneous matrix composed of natural grasslands, sierra forests, riparian forests, livestock areas, and native vegetation remnants (Ministerio de Vivienda Ordenamiento Territorial y Medio Ambiente, 2016).

Figure 1. Location of Valle del Lunarejo Protected Landscape in Northern Uruguay. Source: Ministerio de Ambiente; Ministerio de Vivienda y Ordenamiento Territorial (n.d.).



Sampling and Analysis

From 2021 to 2023, 35 camera traps were installed in different habitats, with a minimum distance of 1 km between stations, prioritizing natural trails, watercourses, forested areas, and grassland edges. Each device remained active for at least 60 consecutive days, totaling 1,877 camera-trap nights. Cameras recorded 20-second videos upon motion detection.

All footage was reviewed manually, and felid records were identified by three independent observers using coat pattern and morphology. Daily activity data were analyzed using Oriana 4.02 software (Kovach, 2011), classifying events into diurnal (08:00–17:00), nocturnal (20:00–04:00), and crepuscular (04:00–08:00 and 17:00–20:00).

Relative frequency was estimated using the Relative Abundance Index (RAI), calculated as:

$$\mathbf{RAI = (C / ES) \times 100},$$

where *C* represents independent records and *ES* the sampling effort (cameras × days). Independent events were considered either different species or the same species separated by more than 24 hours (Monroy-Vilchis et al., 2010).

3 RESULTS

Recorded Species and Relative Frequency

Three small wild cat species were recorded in the study area. *Leopardus wiedii* was the most frequently detected species, with 32 independent events, representing a Relative Abundance Index (RAI) of 1.70. *Leopardus geoffroyi* was recorded 10 times (RAI = 0.53), while *Leopardus munoai* was detected only once (RAI = 0.05).

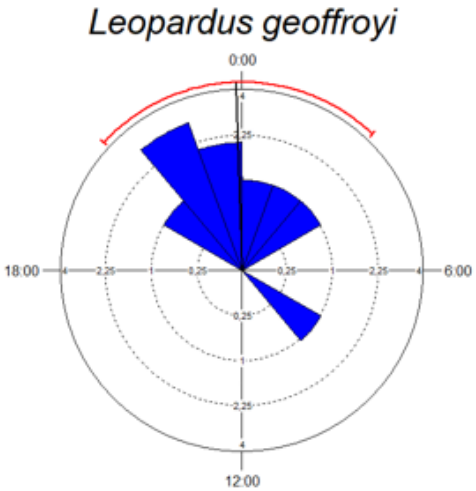
Habitat Use

Records of *L. wiedii* were concentrated in areas with sierra forest and riparian forest cover, reflecting a clear preference for dense forest habitats. *L. geoffroyi* was detected in transitional zones between open grasslands and forested vegetation, suggesting some flexibility in habitat use. In contrast, *L. munoai* was recorded in an open area dominated by grassland and sparse shrub cover, on the edge of a native forest remnant.

The *L. munoai* record represents the first confirmed live detection of the species in over a decade in Uruguay (Turcatti, 2023a). This finding, along with the other two species, constitutes the first simultaneous documentation of all three species in the area.

Activity Patterns

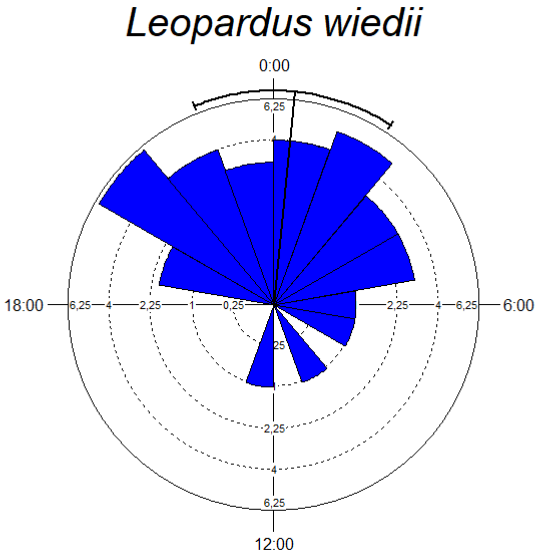
Figure 1: Circadian activity distribution of *Leopardus geoffroyi* during the day. The blue histograms show the activity distribution of the species, the arrow represents the mean vector (μ) with a 99% confidence interval.



Source: Authors' own elaboration (2025).

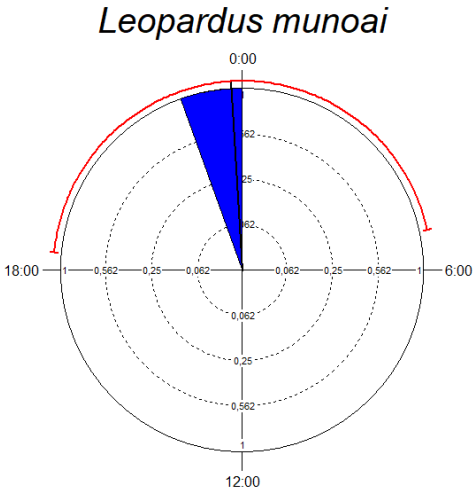
Camera trap detections of *Leopardus geoffroyi* were mainly concentrated between 20:00 and 04:00, with a peak of activity around midnight. Daytime records were absent.

Figure 2: Circadian activity distribution of *Leopardus wiedii* during the day. The blue histograms show the activity distribution of the species, the arrow represents the mean vector (μ) with a 99% confidence interval. Source: Authors' own elaboration (2025).



The majority of *Leopardus wiedii* records occurred between 18:00 and 06:00, with a peak around midnight. Only a few isolated detections were made during daytime hours, between 10:00 and 14:00.

Figure 3: Circadian activity distribution of *Leopardus munoai* during the day. The blue histograms show the activity distribution of the species, the arrow represents the mean vector (μ) with a 99% confidence interval. Source: Authors' own elaboration (2025).



In the case of *Leopardus munoai*, only a single record was obtained during the camera trap monitoring at Valle del Lunarejo, occurring between 20:00 and 22:00.

4 DISCUSSION

The results of this study confirm the coexistence of three Leopardus species in Valle del Lunarejo, consolidating the importance of this area as a key refuge for small carnivores in the Uruguayan Pampa biome. The simultaneous detection of *L. geoffroyi*, *L. wiedii*, and *L. munoai* highlights both the species richness and the ecological integrity of the landscape.

The activity pattern of *L. geoffroyi* revealed a clear preference for nocturnal hours, with a distinct concentration between 20:00 and 04:00. This pattern aligns with findings from other studies conducted in the Pampa region and forested environments in southern Brazil and Argentina, where the species shows primarily nocturnal or crepuscular habits (Di Bitetti et al., 2009; Oliveira-Santos et al., 2012). Such nocturnality may be associated with hunting strategies, thermoregulation, or avoidance of human activity and sympatric carnivores active during the day (Sunquist & Sunquist, 2002). Additionally, L. geoffroyi showed a preference for ecotones between grasslands and forests, consistent with its ecological plasticity and tolerance to modified landscapes (Manfredi et al., 2012).

Leopardus wiedii also exhibited strongly nocturnal behavior, with activity concentrated between 18:00 and 06:00, peaking around midnight. This result is consistent with previous studies reporting nocturnal or crepuscular tendencies across Neotropical forest habitats (Di Bitetti et al., 2010; Oliveira et al., 2010; Sollmann et al., 2013). Its nocturnality may reflect adaptations to arboreal hunting, opportunistic predation, and avoidance of competition or human presence (Sunquist & Sunquist, 2002; de Oliveira, 1998). The high number of detections, particularly in riparian and sierra forests, indicates that these forested remnants provide optimal habitat conditions.

In the case of *L. munoai*, the single detection obtained corresponds to the first confirmed live record of the species in Uruguay in over ten years (Turcatti, 2023a). Although limited, this nighttime record aligns with previous accounts of nocturnal or crepuscular activity in the species and related taxa (Di Bitetti et al., 2010; Oliveira et al., 2010; Trigo et al., 2008). The low detection rate may be attributed to low population density, elusive behavior, use of less accessible habitats, or sampling limitations. Notably, the record occurred in an open edge environment dominated by grasslands and sparse shrubs, supporting earlier habitat descriptions. Given the species' historic under-sampling and misidentification, targeted and long-term monitoring strategies, such as eDNA analysis, occupancy modeling, and attractant-enhanced camera traps, are essential to better understand its ecology and conservation needs.

Overall, the circadian activity patterns of all three species reveal predominantly nocturnal behavior, which may represent a shared strategy to reduce interspecific competition and avoid human interference. The observed temporal overlap suggests the presence of niche partitioning mechanisms primarily based on spatial segregation and microhabitat use, as proposed for other Neotropical felid assemblages (Di Bitetti et al., 2010).

These findings reaffirm the strategic importance of Valle del Lunarejo within Uruguay's National System of Protected Areas. The area plays a vital role in preserving small wild cats amid expanding land-use change. Management plans should prioritize maintaining habitat heterogeneity and promoting ecological connectivity, with special emphasis on monitoring and protecting *L. munoai*, one of the region's most threatened and least-known species.

5 CONCLUSIONS

This study provides solid evidence of the coexistence of *Leopardus wiedii*, *Leopardus geoffroyi*, and *Leopardus munoai* in the Valle del Lunarejo Protected Landscape, reinforcing its value as a key refuge for small wild cats in Uruguay's Pampa biome. The simultaneous detection of these three species, each with distinct habitat preferences and activity patterns, underscores the importance of maintaining environmental heterogeneity and the integrity of native ecosystems.

The finding of *L. wiedii* as the most frequently recorded species challenges the historical perception of its rarity in the country and highlights the critical role of sierra forest remnants in its conservation. The confirmation of *L. munoai* after more than a decade without live records further reinforces the urgent need for species-specific monitoring and protection measures targeting this endemic and poorly known small wild cat.

Amid growing threats from agricultural expansion, habitat loss, and landscape fragmentation, it is crucial to strengthen adaptive management within the protected area, promote regional ecological connectivity, and consolidate conservation initiatives that integrate science, land-use planning, and community participation.

Valle del Lunarejo thus stands not only as a vital biodiversity reservoir, but also as a strategic opportunity for implementing pilot actions for small wild cat conservation in Uruguay, with potential for replication in other parts of the Pampa biome.

Although this study involved a sustained and systematic monitoring effort, some limitations should be acknowledged. The exclusive use of camera traps may have constrained the detection of elusive or low-density species such as *Leopardus munoai*, particularly in less accessible habitats. To overcome these constraints, future research should diversify survey methods, including track stations, scat surveys, and community-based observations, and extend the spatial coverage of

sampling. Continued long-term efforts will be essential to monitor population trends, identify priority areas for connectivity, and guide effective conservation strategies for these species.

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