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First record of the pampas fox *Lycalopex gymnocercus* (Fischer, 1814) at the north-central region of Paraná state, Brazil

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Citación: PEREIRA, A. D., E. A. FRANÇA, M. O. ARASAKI, & A. P. VIDOTTO-MAGNONI. 2022. First record of the pampas fox *Lycalopex gymnocercus* (Fischer, 1814) at the north-central region of Paraná state, Brazil. *Notas sobre Mamíferos Sudamericanos* 4:e22.2.2.

ABSTRACT

The pampas fox *Lycalopex gymnocercus* is a medium sized neotropical canid that is currently documented to occur in Bolivia, Paraguay, Uruguay, Argentina and Brazil. In Brazil its occurrence is described for the Pampas, but the species is currently expanding its distribution to the second plateau of Paraná state and also to São Paulo state. Here we present the first occurrence record of the species in the north-central region of Paraná state, in the third plateau. The expansion of its geographic range may be associated to anthropogenic factors, such as forest conversion to pastures and habitat fragmentation.

Keywords: canid, expansion, fragmentation, range, sympatry

RESUMO - Primeiro registro da raposa do campo *Lycalopex gymnocercus* (Fischer, 1814) na mesorregião Norte Central do Paraná, Brasil. A raposa do campo *Lycalopex gymnocercus* é um canídeo neotropical de porte médio com ocorrência registrada na Bolívia, Paraguai, Uruguai, Argentina e Brasil. No Brasil é comumente observado nos Pampas, mas sua distribuição está expandindo para o segundo planalto paranaense e para o estado de São Paulo. Nesse estudo é descrito o primeiro registro de ocorrência para a mesorregião Norte Central paranaense, no terceiro planalto. A expansão de seu alcance geográfico pode ser promovida por fatores antropogênicos, como a conversão de florestas em pasto e fragmentação da Mata Atlântica.

Palavras-chave: canídeo; expansão; extensão; fragmentação; simpatria

The pampas fox or Azara's fox *Lycalopex gymnocercus* (Fischer, 1814) is a medium-sized canid that ranges from 86 to 106 cm long and weights 3 to 8 kg (Reis et al. 2011). This canid has a thin snout tip [unlike the crab-eating fox *Cerdocyon thous* (Linnaeus,

Recibido el 20 de noviembre de 2021. Aceptado el 25 de enero de 2022. Editor asociado: Francisco Prevosti.



1766)], a characteristic gray-yellowish fur coat with black coloration on the dorsal region and a ventral region lighter than the rest of the body (Lucherini et al. 2004; Reis et al. 2014). The pampas fox is a generalist species, with a diet diversified seasonally (Farias & Kittlein 2008), being primarily based on small mammals and lagomorphs, birds, carcasses, arthropods and fruits (García & Kittlein 2005; Farias & Kittlein 2008; Canel et al. 2016).

Lycalopex gymnocercus occurrence is documented in regions east of Bolivia, west and middle Paraguay, Uruguay, north and middle Argentina and south of Brazil (Lucherini et al. 2004; Lucherini & Vidal 2008; Queirolo et al. 2013). However, there are still some doubts regarding the identity and the species boundaries of South American canids of the genus *Lycalopex* which have not been thoroughly evaluated using molecular data and in some ecological aspects (Prevosti et al. 2013; Chemisquy et al. 2019). In Brazil, it is more frequently observed in the Pampas eco-regions (Morrone 2014) and in the grasslands into the Atlantic Forest up to the transition to the Cerrado, mainly living on open areas such as lowland and high-altitude grasslands (up to 1822 m), secondary forests and forest edges (Reis et al. 2011). In sympatric areas for *L. gymnocercus* and *C. thous* there is a differential preference for habitat, as the first species is more frequent in open habitats and the latter inhabit forest areas more frequently (Lucherini 2016). While the species is already observed in sympatry with *C. thous* in several areas, its expansion to new areas on the northern limit may favor sympatry events with *Lycalopex vetulus* (Lund, 1842) (Queirolo et al. 2013). However, information on the species distribution limits and extension of the superposition with other species is still uncertain (Lucherini 2016).

Globally and nationally the species is assessed as Least Concern (LC) (Queirolo et al. 2013; Lucherini 2016). However, for states in which there are few occurrence records such as Paraná, it is classified as Not Evaluated (NE) (Paraná 2010). It is necessary to better evaluate the species distribution in Paraná, since it may be threatened due to its restricted distribution, habitat destruction, hunting and depletion of food sources (Margarido & Braga 2004). Information gaps and biases on the species distribution directly affect the assumptions about population dynamics, biodiversity conditioning processes and estimates for threats on the species conservation (Hortal et al. 2015).

Biodiversity inventories and points of occurrences for species distribution provide essential information about the ecology of species and ecosystems, and are the ground for plans and efforts for conservation in local, regional and national scales (Silveira et al. 2010). In this sense, we report the first formal record of *L. gymnocercus* (pampas fox) for the north-central region of Paraná in order to update the distribution data for the species in the state.

The photographic record for the occurrence of *Lycalopex gymnocercus* was made by a student at the State University of Londrina (UEL) at 7:46 AM on September 19, 2020, on an open field near to the university buildings (latitude -23.3248; longitude -51.2033) (Fig. 1). The image was provided to the Animal Ecology and Behavior Lab (LECA) and the species was identified based on morphological characters described on bibliographic references (e.g., Reis et al. 2011, 2014).



The university campus (latitude -23.3265; longitude -51.2037) is located at the northwest of Londrina municipality, northern of Paraná state, Brazil. The total area of the university is 2,226 km², with 181.7 km² of built areas and several open and green areas, generally associated to some vegetation cover and sparse fruitful trees. There is also a 20-hectare fragment of Atlantic Forest known as “Horto Florestal”, composed by seasonal semideciduous forest in various ecological succession stages (Reis et al. 2012). The fragment has a biodiverse flora that provides food to several mammal species that occur in the area. Despite that, the record was made approximately 1km away from the fragment edge, at the opposite side of the institution, near the PR-445 state road.

We assessed the current distribution of *L. gymnocercus* from data points in Atlantic Mammal, SpeciesLink, Global Biodiversity Information Facility (GBIF) databases and the Red Book of Threatened Fauna on the State of Paraná (Mikich & Bérnils 2004), and the IUCN geographic range (Lucherini 2016). We compared the assessed distribution with the new record in the present study and found a distance of approximately 160 km (Cartesian) from the current northern limit for the species occurrence [Arapoti: latitude -24.0896; longitude -49.9678] (Fig. 2).

Due to habitat changes, mainly related to deforesting and land use, *L. gymnocercus* may be broadening its distribution limits in Brazil. These factors favor the presence of the species at Santa Catarina and Paraná states, and the expansion of São Paulo state (Queirolo et al. 2013). The species was recorded at the southwest of São Paulo by Lemos & Azevedo (2009) however, more samplings are required in the region in order to establish its real limits of distribution. In the distribution proposition suggested by Queirolo et al. (2013), *L. gymnocercus* reaches the Paraná-grassland phytophysiognomy. Based on these limits, the hypothesis is that the species is spreading to the north through the grasslands of the second plateau of Paraná, one of the five geomorphological units of the State (i.e., coastal plain, Serra do Mar, first, second and third plateau), in which grasslands are similar to the Pampas (Maack 2017; see Fig. 2) where the species is more abundant. The previous occurrence records assessed here (Fig. 2) emphasize the presence of the species at the second plateau of Paraná, and support the distribution proposition of Queirolo et al. (2013). Still, the species was also recorded at the third plateau of Paraná and our record evidence potential expansion of the distribution to the north of the third plateau.

As opportunistic predators, canids respond functionally to temporal and spatial variation in prey availability (see reviews in Sillero-Zubiri et al. 2004). Dietary distinctions within neotropical canid populations can be occasioned by habitat patchiness and small scale heterogeneity in prey distribution (Sovada et al. 2001; Pia et al. 2003). Therefore, the expansion of *L. gymnocercus* distribution may be associated to its flexible diet, habitat use and behavior (Di Bitetti et al. 2009; Caruso et al. 2016), that can be significantly distinct in populations living in forests, anthropized landscapes and grassland areas.

Middle-sized canids or omnivorous species, such as the pampas fox, do not suffer direct exclusion by competition with domestic predators (Nanni 2015). However, their ecology and behavior can be modified by reductions on natural prey availability and



a rise of livestock abundance due to the conversion of natural vegetation to pastures (Pia et al. 2003; Nanni 2015). For instance, in agroecosystems of central Argentina the species is known for its adapted diet for livestock predation (i.e., lambs; Santo-Domingo et al. 2021). Willing to reduce the predation of lambs, ranchers promote hunting pressure and thus, behavioral adaptation on the pampas fox. It was observed that populations in open areas shifted their activity to dusk, avoiding nighttime and consequently, hunters (Santo-Domingo et al. 2021).

The lack of information on biological aspects of some Brazilian mammals like *L. gymnocercus* fits into one of the main gaps in knowledge of biodiversity, the Wallacean shortfall (Hortal et al. 2015). The Wallacean shortfall refers to the lack of knowledge about the geographic distribution of species (Lomolino 2004). Regarding to *L. gymnocercus*, information about its distribution limits and extension of superposition with congeneric species is uncertain. Some studies found genetic evidence for hybridization between *Lycalopex vetulus* and *L. gymnocercus*, as specimens sampled in the contact zone for both species in São Paulo state shared mitochondrial DNA haplotypes (Favarini 2011; Garcez 2015). Authors suggested that the sympatry of the species and hybridization is due to anthropogenic causes, since the presence of the Pampas Fox in São Paulo may derive from an ongoing invasion of human-induced open habitats, such as pastures, and both species would be naturally isolated by Atlantic Forest, highly fragmented in Paraná and São Paulo (Favarini 2011; Garcez 2015).

Occurrence records in northern Paraná and southwest São Paulo states, and hybridization evidence in São Paulo state imply that more sampling effort for *L. gymnocercus* occurrence data is required, in order to review its current accepted geographic distribution. In this sense, data presented in this study are a basis for new studies to comprehend the species' current distribution and investigate how *L. gymnocercus* populations adapt to habitat modifications.

ACKNOWLEDGMENTS

We thank the student Julia Ayumi Ikeda Kawasaki for providing us with the photographic record of *Lycalopex gymnocercus* in the State University of Londrina.





Figure 1. Photographic record of *Lycalopex gymnocercus* in the State University of Londrina (latitude -23.3248; longitude -51.2033), Paraná, Brazil.

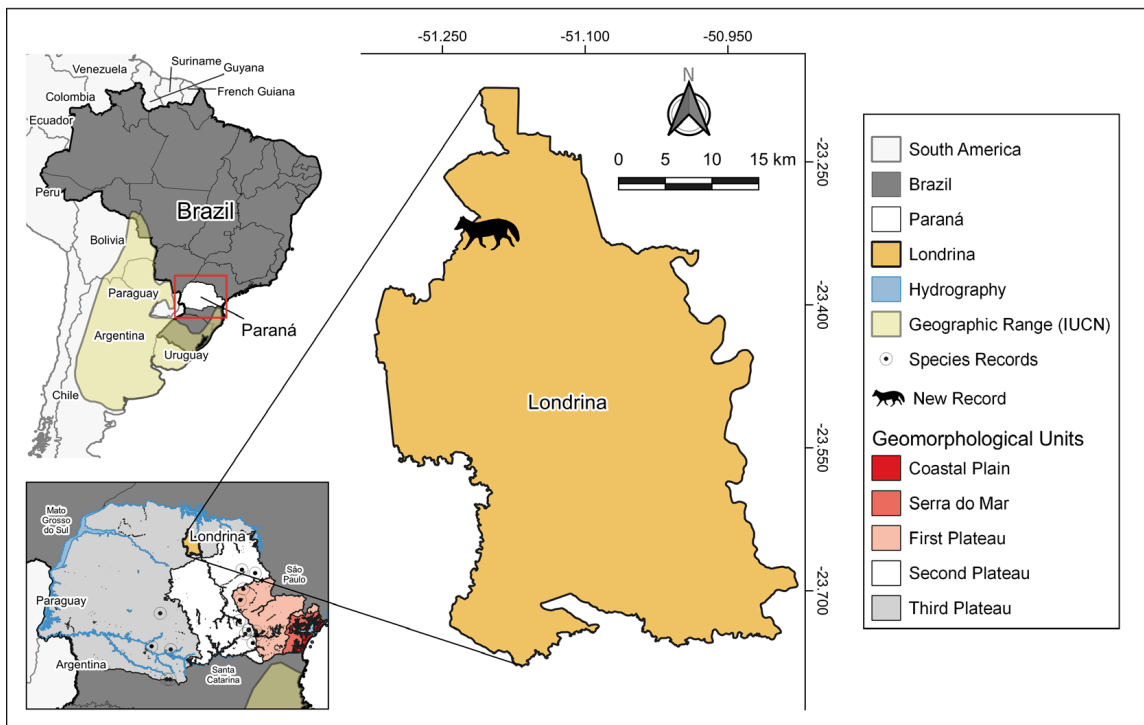


Figure 2. Location of the new record for *Lycalopex gymnocercus* in Londrina, third plateau of Paraná, Brazil, species previous records in Paraná state and global geographic range, according to IUCN.



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