



## RECORD OF A LEUCISTIC PAMPAS FOX *Lycalopex gymnocercus* (CARNIVORA: CANIDAE) IN NORTHEASTERN OF ARGENTINA

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**Abstract:** Leucism is a frequent chromatic mutation in mammals that causes partial or complete fur depigmentation. This type of mutation is interesting because they have physiological and ecological implications. We report here the first record of leucism in a pampas fox *Lycalopex gymnocercus* (Carnivora: Canidae), photographed using a camera trap in the northeast of the province of Corrientes, Argentina. Although cases of hypopigmentation are apparently very rare among pampas foxes, they could actually be more frequent than previously assumed. Given the ecological and physiological importance of these anomalies, researchers should report all records of this type in order to understand the degree to which these genetic variants are present in wild populations of different species of vertebrates.

**Keywords:** canids; chromatic mutation; hypopigmentation.

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Mutations that affect pigmentation are common among carnivores, and atypical individuals are frequently mentioned in the literature (Delibes *et al.* 2013). Melanism, a mutation that produces an excess synthesis of the pigment melanin, produces black or dark brown morphs (van Grow 2006, Ali & Naaz 2018). It is frequently observed in some North American canids, such as gray (*Canis lupus*) and red (*C. rufus*) wolves, as well as in red foxes (*Vulpes fulva*), but it rarely occurs in Europe and Asia (Castelló 2018). However, partial or total lack of melanin synthesis is rare among wild carnivores, since it has no evolutionary adaptive importance (except in snow-covered regions) and therefore these morphs are generally removed from natural populations (Ozoga & Harger 1996, Caro 2005). Albinism is defined as the complete absence of melanin in hair, eyes and skin as a result of an inherited absence of tyrosinase (van Grow 2006, Ali & Naaz 2018). This enzyme is necessary for the process of melanin production

in vertebrates (Hubbard *et al.* 2010, van Grow 2013). Albino animals have completely white fur and red eyes. The pink or red color of exposed skin areas and eyes comes from blood, which can be seen through colorless tissues (Miller 2005, van Grow 2006). Piebaldism, in contrast, is an autosomal dominant disorder characterized by congenital white skin (leukoderma) and white hair (poliosis) on the forehead, frontal tuft, trunk and extremities, but animals with this mutation have their eyes are of normal color. This anomaly is caused by improper migration of neural crest-derived melanoblasts in embryo (Oiso *et al.* 2013, Ali & Naaz 2018). Leucism is defined as a partial or total lack of eumelanin and pheomelanin in the hairs as a result of inherited disorder of the deposition of these pigments, producing white or whitish hair and pale skin, sometimes with patches of black hairs. As in piebaldism, the eyes and other bare areas show normal color (van Grow 2006, Eppley *et al.* 2010, Nedyalkov *et al.* 2014).

These color variations in wild animals used to be described as mere anecdotal curiosities (Delibes *et al.* 2013). Interest in color polymorphisms emerged only in recent years. Important advances have been made on studying the genetic basis of pigmentation in mammals, and this have made it possible to assess the relationship between genotype and phenotype in an evolutionary and ecological context (*e.g.*, Hoekstra 2006, Anderson *et al.* 2009, Hubbard *et al.* 2010, Delibes *et al.* 2013).

In the Order Carnivora, leucistic specimens have been reported for the families Mustelidae (Tortato & Althoff 2007, Arriaga-Flores 2016, Talamoni *et al.* 2017, Matos Dias 2018, Olson & Allen 2019), Otariidae (Acevedo & Aguayo 2008), Procyonidae (Silva-Caballero 2014), Felidae (Cronemberger *et al.* 2018) and Canidae (López-González 2011, Arroyo-Arce *et al.* 2019, Oliveira *et al.* 2019).

The pampas fox, *Lycalopex gymnocercus* (Carnivora: Canidae) is a relatively common species in southern South America, ranging from eastern Bolivia to western and central Paraguay, southern Brazil, Uruguay, and northern and central Argentina (Lucherini & Luengos Vidal 2008, Macdonald & Sillero-Zubiri 2010). It inhabits high grasslands, open forests (both mesophilic and xerophilous), wetlands, coastal dunes and even livestock and crop areas (Medel & Jaksic 1988, Lucherini & Luengos Vidal 2008, Castelló 2018). It varies in color throughout its geographic distribution, but in northeastern Argentina its fur is generally brindle gray, with belly and inner surface of legs pale gray to whitish. The top and sides of the head are reddish, the lower mandible is black. The hind limbs are gray laterally, with a black spot on the lower rear. The tail is gray, with a blackish line running along the center of the back, a black spot on the upper side and black tip (Castelló, 2018) (Figure 1a and 1b).

There appears to be a single record of a leucistic canid in the Neotropical region, an individual of *Cerdocyon thous* (Carnivora: Canidae), photographed in northeastern Brazil (Oliveira *et al.* 2019). We present here the finding of a leucistic individual of *L. gymnocercus* in the province of Corrientes, in northeastern Argentina.

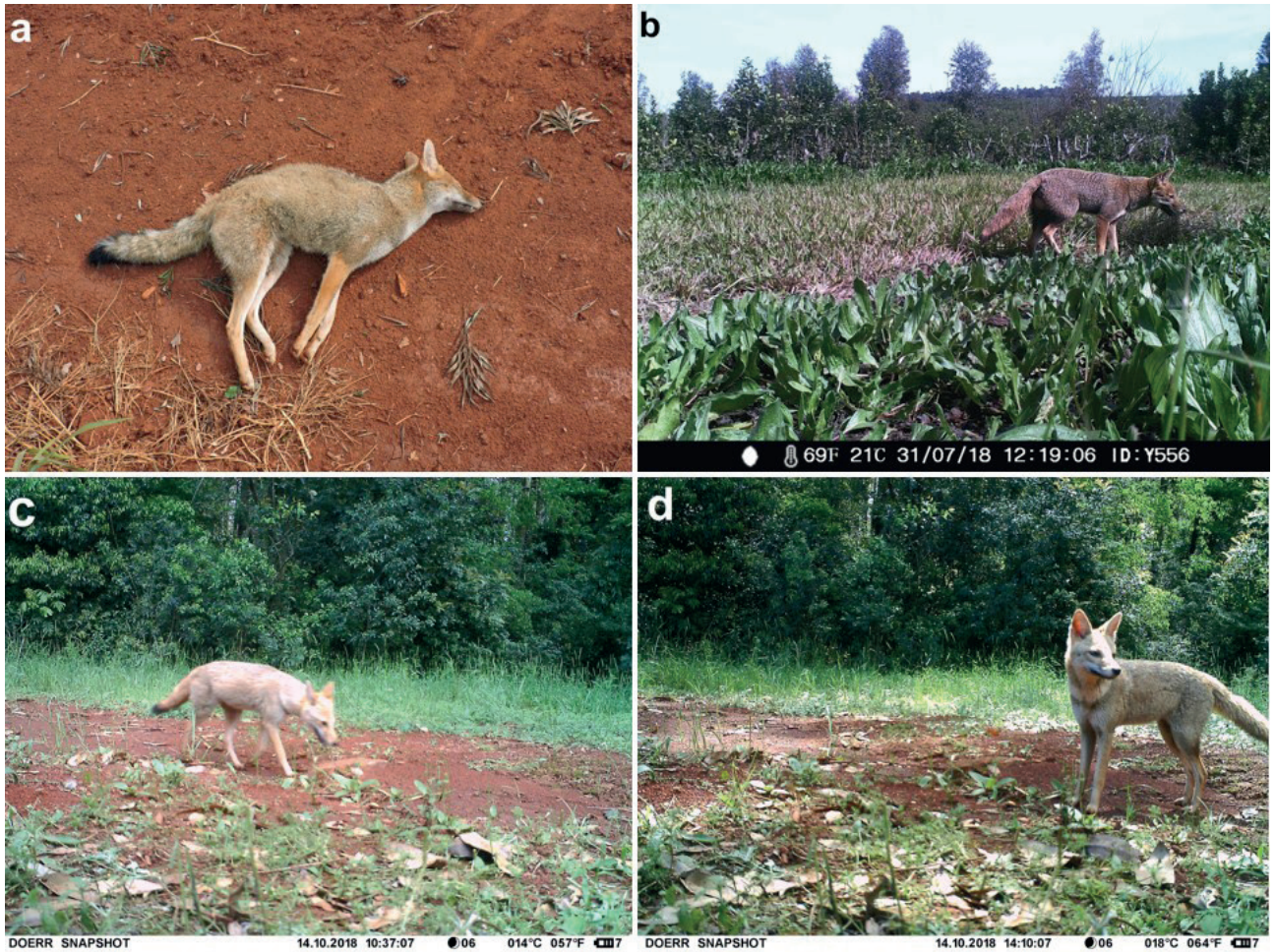
The record was done in the territory of

Establecimiento Las Marías (28°06'39" S; 56°3'23" W), a yerba mate-producing company located in the Santo Tomé department, Corrientes province, northeast Argentina. The area has undulating relief, with hills reaching an average of 130 meters above sea level (Popolizio 1989). The climate is subtropical, with no dry season and a higher concentration of rainfall in the summer (National Meteorological Service 2015). The area belonging to this company occupies 30,000 ha. It contains yerba mate, *Ilex paraguariensis* (Aquifoliales: Aquifoliaceae), tea, *Camellia sinensis* (Ericales: Theaceae), pine (*Pinus* spp.) and eucalyptus (*Eucalyptus* spp.) plantations, as well as some pasture lands for livestock. There are also a few forest patches (Paranaense Forest) in good state of conservation.

Between February 28, 2017 and July 27, 2018, seven Dörr® and Hunting Trail® camera traps, were deployed 1 km apart from each other to record the presence of mammals in the area. The camera traps were rotated sequentially among 121 sampling stations, remaining 15 days in each station; after that period, the images obtained were downloaded to a laptop, and the cameras relocated to another station. The total sampling effort consisted of 3668 camera trap/days. A total of 205 records of *L. gymnocercus* of normal coloration (Figure 1b), and two records of a leucistic individual (Figure 1 c and 1d), were obtained. It was assumed that the two records of a leucistic fox corresponded to the same individual, since the records were made at the same trapping station. This was an adult specimen, but its sex could not be determined. Its general coloration was yellowish white, with light brown areas on the sides of the chest and on the back of the hind legs. The eyes, rhinarium, lower jaw and tail end were of normal color. The tail looked somewhat reddish, but this is a common consequence of rubbing it on the ground, which in the region under study has a characteristic dark red color and gives a reddish tint to the fur of wild and domestic mammals, and even to the plumage of terrestrial birds.

Our finding constitutes the first record of a leucistic pampas fox. The only known case of abnormally colored fur in this species corresponds to an individual with piebaldism photographed in southern Brazil (Mello *et al.*





**Figure 1.** a and b) Specimens of pampas fox *Lycalopex gymnocercus* with normal coloration (a: individual run over on a dirt road; b: individual recorded by a camera trap); c and d) the leucistic specimen reported in this work. All images come from the Establecimiento Las Marías, Corrientes, Argentina.

2020). Considering the sampling period and the number of specimens of this species that have been recorded, we believe that leucism is very rare in the area. This agrees with the results reported by Miller (2005), who pointed out the low rate of occurrence of hypopigmentation cases in vertebrate populations.

It is generally considered that genetic mutations that alter pigmentation patterns have negative effects on the animals that possess them, such as low reproductive success, a higher probability of being predated and, in general, a lower survival rate (Caro 2005, Miller 2005, Eppley *et al.* 2010, Arroyo-Arce *et al.* 2019). However, the results of different studies contradict these claims. Studies carried out with normally colored individuals of *Microtus pennsylvanicus* (Rodentia: Cricetidae) and with albino individuals suggest that, in habitats with good vegetation cover and abundant food, hypopigmentation might not be a

disadvantageous trait, since it was not associated with alterations in population dynamics or with an increase in selective predation mortality (Peles *et al.* 1995). Other studies, some of them in captive specimens, have not found that predators have a significant preference for albino or hypopigmented prey animals, a more decisive factor being the shape and movements of the prey (Mueller 1977, Troncone & Silveira 2001, Miller 2005).

Although cases of hypopigmentation are apparently very rare among pampas foxes, they could actually be more frequent than previously assumed. It's possible that field observations of these chromatic anomalies are not regularly reported in scientific journals, leading to an underestimation of their frequency of occurrence (Abreu *et al.* 2013). Given the ecological and physiological importance of these anomalies, researchers should report all records of this type in order to understand the degree to which these

genetic variants are present in wild populations of different species of vertebrates (Abreu *et al.* 2013, Mello *et al.* 2020).

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