



FIRST RECORD OF PIEBALDISM IN *Lycalopex gymnocercus* (CARNIVORA, CANIDAE) IN THE PAMPA BIOME, SOUTHERN BRAZIL

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Abstract: Several cases of albinism, melanism, leucism and piebaldism in mammals have already been reported in the scientific literature. Such genetic mutations are important to be reported, because it can affect the ecological interactions of Pampas Fox individuals with piebaldism, such as predation and mating. Here we report the first case of piebaldism for the Pampas Fox *Lycalopex gymnocercus* (Carnivora, Canidae), observed in a rural area within the municipality of Bagé, Rio Grande do Sul state, Southern Brazil.

Keywords: chromatic mutation; hypopigmentation; Pampas Fox; pigmentation anomaly.

Coloration anomalies in vertebrates may occur occasionally, due to excess or deficit in melanin synthesis in some body parts or in the whole body (Miller 2005, Acevedo & Aguayo 2008). In Neotropical mammals, the most frequently reported cases are albinism, melanism and leucism, although cases of piebaldism are more rarely reported (Abreu *et al.* 2013, Lucati & Lopez-Baucells 2016).

Currently, there is confusion in the literature for the classification of hypopigmentary mutations, especially between 'leucism', 'partial albinism' and 'piebaldism' (Lucati & López-Baucells 2016). In general, leucism can be defined as the absence of cells that synthesize melanin, which results in the loss of the complete coloration of a particular pigment or of all the integument pigmentation, causing the

whitening of animals that would be originally dark (Miller 2005, van Grouw 2013). Individuals affected by this mutation do not present anomalies in eyes' coloration, such as occurs in albinism (Miller 2005, van Grouw 2013). Albinism is an inheritable disorder, of which the affected individual presents pale skin, white fur/feathers and red eyes, resulting from the complete lack of melanin (van Grouw 2006, Hofreiter & Schöneberg 2010). Piebaldism, in the other hand, is characterized by the lack of melanin in some parts of the body, but with standard coloration in the eyes, affecting only the coloration of the skin and fur/feathers (Fertl & Rosel 2002). This mutation pattern is similar to leucism, although in piebaldism, the melanocyte development is only locally disrupted. Animals affected by this

mutation present irregularly distributed white spots on the body (see Abreu *et al.* 2013, Lucati & Lopez-Baucells 2016). Piebaldism is also often called ‘partial leucism’ or ‘partial albinism’ by some authors (Romero & Tirira 2017), because it is difficult to determine, only by visual evaluation, the genetic mutation that resulted in the white spotted phenotype (Zalapa *et al.* 2016).

In Southern Brazil, some cases of pigmentation anomalies in wild mammals have already been reported, for instance, in rodents, such as *Delomys dorsalis* (Rodentia, Cricetidae; Cademartori & Pacheco 1999) and *Dasyprocta azarae* (Rodentia, Dasyproctidae) (Oliveira 2009a), primates *Alouatta guariba clamitans* (Primates, Atelidae) (Fortes & Bicca-Marques 2008), cervids *Mazama gouazoubira* (Artiodactyla, Cervidae) (Oliveira 2009b), carnivores *Conepatus chinga* (Carnivora, Mephitidae) (Mello *et al.* 2016), and marsupials *Didelphis* sp., (Didelphimorphia, Didelphidae) (Abreu *et al.* 2013). However, for wild canids, the only record in the literature is for a leucistic Crab-eating Fox *Cerdocyon thous* (Carnivora, Canidae), observed in the northwestern region of Brazil, Caatinga Biome, in the Agricultural Sciences campus of the Universidade Federal do Vale do São Francisco, located in the rural zone of the municipality of Petrolina, state of Pernambuco (Oliveira *et al.* 2019).

Lycalopex gymnocercus (G. Fischer, 1814) (Pampas Fox) is a canid that inhabits grassland areas, has crepuscular and nocturnal habits, and is distributed in Bolivia, Paraguay, Argentina, Uruguay and South Brazil (Cheida *et al.* 2011, Queirolo *et al.* 2013, Queirolo 2016). In southern Brazil, especially in the state of Rio Grande do Sul, this species is considered abundant and often peri-urban, and tolerates high levels of anthropogenic habitat modification (Silva 1994, Queirolo *et al.* 2013). *Lycalopex gymnocercus* occur in open grassland environments, and may occupy small native forests and *Pinus* farm (Silva 1994). The species may reach one meter in length, and 4-7 kg in weight. The typical coloration is yellowish-gray on the back and a whitish tone in the abdomen (Canevari & Balboa 2007, González & Martínez-Lanfranco 2010, Cheida *et al.* 2011). A darker band is highlighted on the back. The muzzle has a dark color, ears and head in a rust-brown tonality, and the tail varying from grayish, reddish and black colors (Silva 1994,

Canevari & Balboa 2007, González & Martínez-Lanfranco 2010, Cheida *et al.* 2011).

On January 10, 2019, about 17:30 h, an adult *L. gymnocercus* individual of indeterminate sex was observed with depigmentation in the fur, differing in relation to the species pattern of coloration. The locality of this record is popularly known as “Olhos D’água” (31°12’40.5” S, 53°53’21.8” W, *datum* SAD69), in the municipality of Bagé, Rio Grande do Sul state, Brazil (Figure 1). This region belongs to the Pampa biome, in which open grasslands predominate in transition with small forest fragments, wetlands and artificial lakes (IBGE 2004). Composed by small farms, the site where the record was made is approximately 24 km northeast from the urban area of the municipality of Bagé.

The individual of Pampas Fox with piebaldism presented depigmentation in a whitish tonality on the head and ears, mainly, but it is also noticeable that such tonality also occurs spotted in other body parts. The muzzle is also depigmented to a pinkish hue (Figure 2), distinct from the original pattern of the species. This pattern seems to be a case of piebaldism, thus confirming the first documented record of color mutation for this species. At the time of the record, the Pampas Fox with piebaldism was close to another normal-stained specimen and apparently the individuals were searching for food on the edge of an artificial reservoir that had ruptured and drained water into the open field, where we also observed the presence of fishes.

Probably, there are many cases of chromatic mutation in wild mammals that were not reported yet in the literature (Abreu *et al.* 2003, Lucati & Lopez-Baucells 2016). However, the disclosure of such cases in the vertebrate fauna became important since it may cause behavioral implications on aberrant colored individuals, as well as interfere in the breeding success (Abreu *et al.* 2013, Aximoff & Rosa 2016, Mello *et al.* 2016). Color aberrations, also called pigmentation anomalies, can result from both genetic and environmental causes. Chromatic mutations, which are genetic-based color anomalies, mainly affect the production of melanin, eumelanin and pheomelanin, through variations in the oxidation processes, often dependent from the presence/absence of the enzyme tyrosinase (van Grow 2006). However, it is important to highlight that environmental pressures may also control the production of

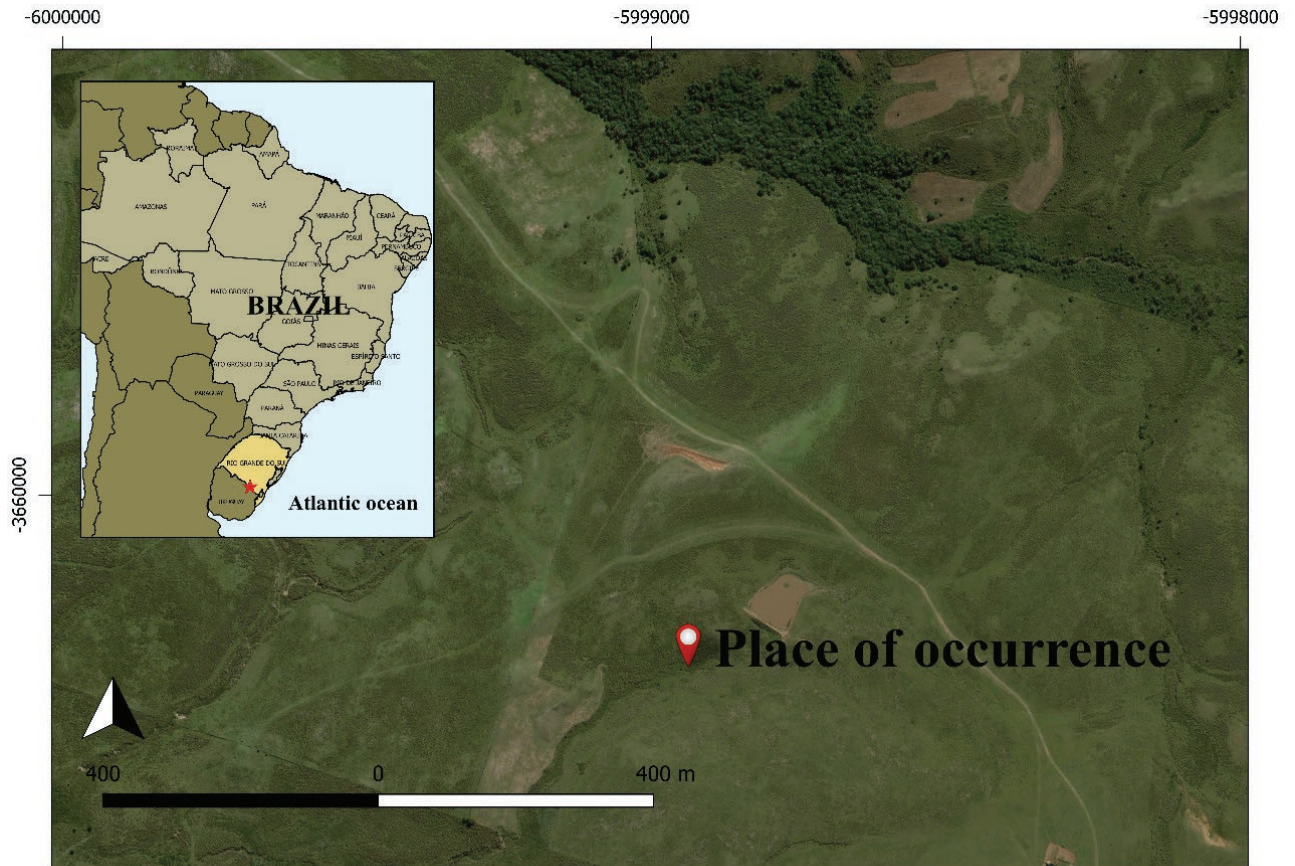


Figure 1. Record location of the the individual of Pampas Fox *Lycalopex gymnocercus* (Carnivora, Canidae) with piebaldism, in the municipality of Bagé, Rio Grande do Sul state, Brazil.

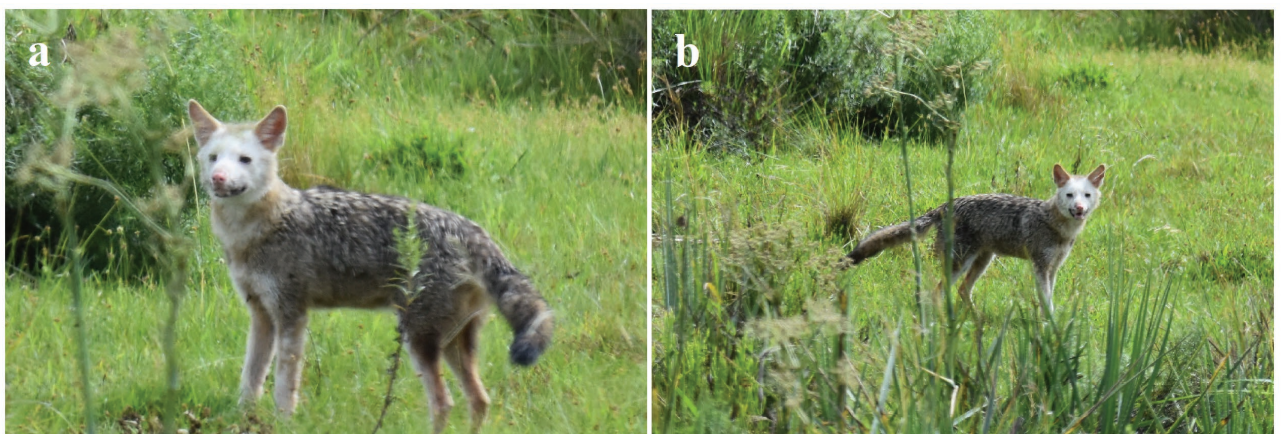


Figure 2. Piebaldism in Pampas Fox *Lycalopex gymnocercus* (Carnivora, Canidae) in the municipality of Bagé, Rio Grande do Sul state, Brazil. Note the depigmentation mainly on the head and ears region, and on the muzzle and some other sparse spots slightly depigmented along the body.

pigments in wild animals. Well-known examples of diet-based coloration patterns is the flamingo (Phoenicopteriformes, Phoenicopteridae), which depends on red carotenoids provided by their natural prey to maintain their pinkish coloration, otherwise becoming whitish (Baron *et al.* 2008) and possibly being mistaken for a leucistic individual by an inexperienced observer.

Furthermore, we suggest that the area where the record was made should be monitored in order to evaluate the anthropogenic pressures upon this environment. This may contribute to the understanding of the chromatic anomaly case reported here. Further studies focused on reporting chromatic anomaly cases and the frequency of these cases are needed to a better understanding of chromatic variations in the vertebrate fauna.

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