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Leucism in *Akodon affinis* (Allen, 1912) (Rodentia: Cricetidae)

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Leucism is a condition where animals show a loss of pigments on certain parts of their skin, without affecting soft tissue, a condition that has been poorly reported for Neotropical rodents. Therefore, our goal was to report leucism for *Akodon affinis*, an endemic species from Colombia, and to analyze the pattern of leucism prevalence in different populations. *A. affinis* specimens deposited in the Mammals Collection of Universidad del Valle (UV) were examined, and any traces of leucism and its prevalence were recorded for 12 different localities where this species was found. These localities were sampled in different years. The association between incidence of leucism and sex was assessed using a Two-tailed Fisher's exact test. A total of 11 individuals from five localities displayed traces of leucism in different parts of their body (Table 1, Appendix 1), including cheeks, dorsum and venter (Figure 1). The analysis revealed that the incidence of leucism was higher in males vs. females. Traces of leucism were most frequent in the dorsum than any other part of their body. Although this species is considered as a Least Concern by the International Union for Conservation of Nature (IUCN), these findings suggest that populations of *A. affinis* might be experiencing inbreeding; however, more information is needed to establish the reproductive and survival consequences of this condition on *A. affinis* populations.

El leucismo es una condición donde los animales presentan una pérdida de pigmentos en ciertas partes de su piel, sin afectar tejido blando, condición que ha sido pobremente reportada para roedores neotropicales. Por lo tanto, nuestro objetivo fue reportar leucismo en *Akodon affinis*, una especie endémica de Colombia, y analizar su patrón de prevalencia en diferentes poblaciones. Una revisión de los individuos de *A. affinis* depositados en la Colección de Mamíferos de la Universidad del Valle (UV) fue llevada a cabo, donde se registró información de leucismo y su prevalencia para 12 localidades diferentes donde esta especie fue encontrada. Estas localidades fueron muestreadas en diferentes años. La asociación entre la incidencia de leucismo y el sexo se evaluó con una prueba exacta de Fisher a dos colas. Un total de 11 individuos de cinco localidades diferentes fueron encontrados con rastros de leucismo en diferentes partes de su cuerpo (Tabla 1, Apéndice 1), incluyendo sus mejillas, dorso y vientre (Figura1). Los resultados indican que la incidencia de leucismo fue mayor en machos que en hembras. Por otro lado, los rastros de leucismo fueron más frecuentes en el dorso en comparación a las otras partes del cuerpo. Aunque esta especie es considerada como Preocupación Menor por la Unión Internacional para la Conservación de la Naturaleza (UICN), estos hallazgos sugieren que las poblaciones de *A. affinis* pueden estar sufriendo de endogamia; sin embargo, es necesaria más información para establecer las consecuencias de esta condición sobre la reproducción y supervivencia de las poblaciones de *A. affinis*.

Key words: Colombia; Colombian grass mouse; conservation; endemism; melanin; population.

Introduction

Leucism is a condition where animals show loss of pigmentation on certain parts of the skin, without affecting soft tissue (Buckley 1982). In mammals, pigmentation results from the synthesis and distribution of melanin (Hearing and Tsukamoto 1991), which depends on several enzymatic factors that modulate pigmentation, especially tyrosinase (Hearing and Tsukamoto 1991; Oetting *et al.* 2003). Melanin plays important roles, including protective coloration, communication, sexual selection, absorption of free radicals and body protection from ionizing radiation (Levine and Krupa 1966; Hearing and Tsukamoto 1991; Caro 2005; Camargo *et al.* 2014). Leucism has been observed in small mammals such as bats (Velandia-Perilla *et al.* 2013) and rodents (Oliveira 2009; Camargo *et al.* 2014; Brito and Valdivieso-Berneo 2016). However, in Neotropical rodents, this condition is barely known, and it has only been reported in a few species (reviewed by Brito and Valdivieso-Berneo 2016).

The Colombian grass mouse, *Akodon affinis* (Allen 1912) (Cricetidae), is a medium-sized Neotropical rodent characterized by uniform dusky brown upper parts with yellowish hair tips, giving an overall olivaceous effect, and dark grayish brown venter with olivaceous hair tips (Pardiñas *et al.* 2015). This species is endemic from the Colombian Andes and is the only representative of the genus in this country (Pardiñas *et al.* 2015; Ramírez-Chaves *et al.* 2016). Considering the limited information on the population and natural history of this species (Pardiñas *et al.* 2015), our main goal was to report leucism in *Akodon affinis* for the first time, and its incidence in populations inhabiting different Andean mountain ranges.

Material and methods

A comprehensive examination of the *Akodon affinis* specimens deposited in the Mammals Collection of Universidad del Valle (UV), Colombia, was carried out. We recorded information on the incidence of traces of leucism for the 12 different localities where this species has been recorded. These localities were sampled across different years, mostly during fieldwork practices of Biology courses at UV, using

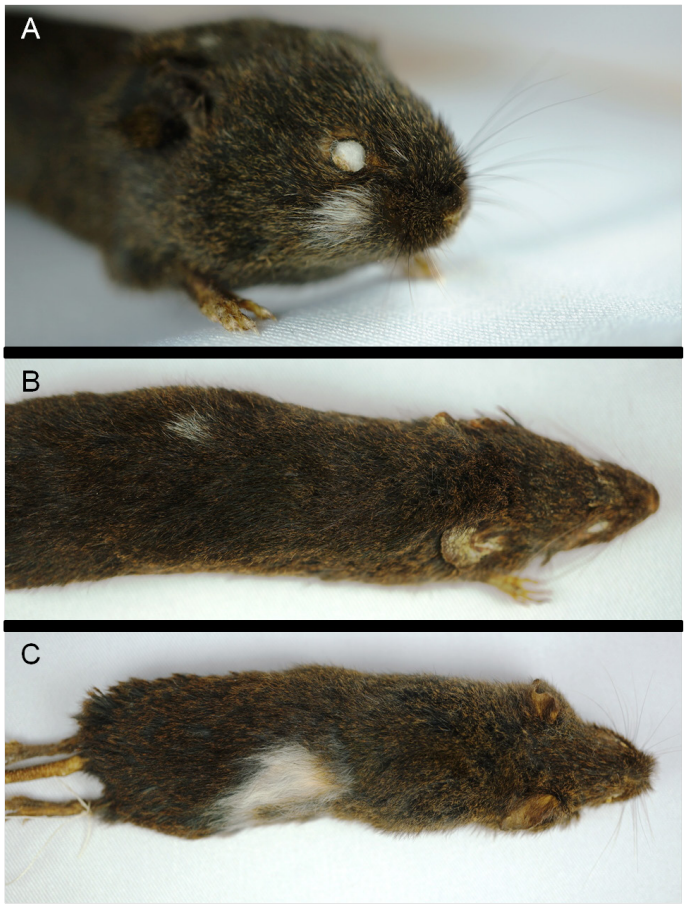

Figure 1. Leucism in individuals of *Akodon affinis* from Colombia: A) Spots on the right cheek and next to the ear (UV 14,440). B) Spot on the dorsum (UV 13,343). C) Wide spot from dorsum to venter (UV 12,025). Photographs by L. Ruano.

100 to 200 Sherman traps (200 in most cases, V. Rojas-Díaz pers. comm.). We used a two-tailed Fischer´s exact test to explore the association between incidence of leucism and sex. For this analysis we only considered the localities (with all the individuals in each) where leucism was detected.

Results

A total of 11 out of 96 (11.46 %) individuals were found to show traces of leucism in different parts of their body (Table 1, Appendix 1), including cheeks, dorsum and venter (Figure 1). The dorsum was the part where most individuals showed traces of leucism ($n = 8$), followed by cheeks ($n = 5$) and venter ($n = 1$). Some individuals presented more than one part of their body with traces of leucism. The analysis showed a significant association between sex and leucism (odds ratio = 8.965, $P = 0.021$), with males having a higher-than-expected incidence of leucism. Leucistic individuals were collected at five different localities (Appendix 1) from the Western and Central Andes of Colombia (Figure 2). The incidence of leucistic individuals per locality was high (Table 2), but fluctuated over time. There were more localities with leucistic individuals in the Central Andes than in the Western Andes (Figure 2).

Table 1. Traces of leucism in individuals of *Akodon affinis* (Allen, 1912) from Colombia.

Locality	Specimen	Sex	Traces of leucism
Florida	UV 3570	♂	Multiple spots on dorsum and rostrum
	UV 3571	♂	Multiple spots on dorsum
	UV 3573	♂	Multiple spots on dorsum
	UV 3575	♂	Multiple spots on dorsum and left cheek
	UV 3578	♀	Spot on dorsum
	UV 10867	♂	Spot on left cheek
Palmira	UV 12025	♂	Wide spot from dorsum to venter
Buga	UV 12414	♂	Spot on dorsum
El Cairo	UV 13343	♂	Multiple spots on dorsum
Pereira	UV 14440	♂	Spot on right cheek and next to the ear
	UV 14488	♂	Spot on left cheek

Discussion

This paper reports, for the first time, information on leucism in *Akodon affinis* populations and its incidence over time in several localities. Our results suggest that the presence of leucism in the sampled populations is as high as the incidence found for *Akodon mollis* in Cordillera de Chilla, Ecuador, a highly fragmented habitat (Brito and Valdivieso-Berneo 2016). The incidence of leucism in *A. affinis* is significantly associated with sex, and appears mainly on their dorsum and rostrum. However, there is insufficient information to assess the potential influence of leucism on survival (visibility to a predator) or reproduction (sexual selection).

It has been proposed that leucism can be the result of skin wounds in burrowing rodents of the Family Geomyidae (S. T. Álvarez-Castañeda pers. com.). However, since

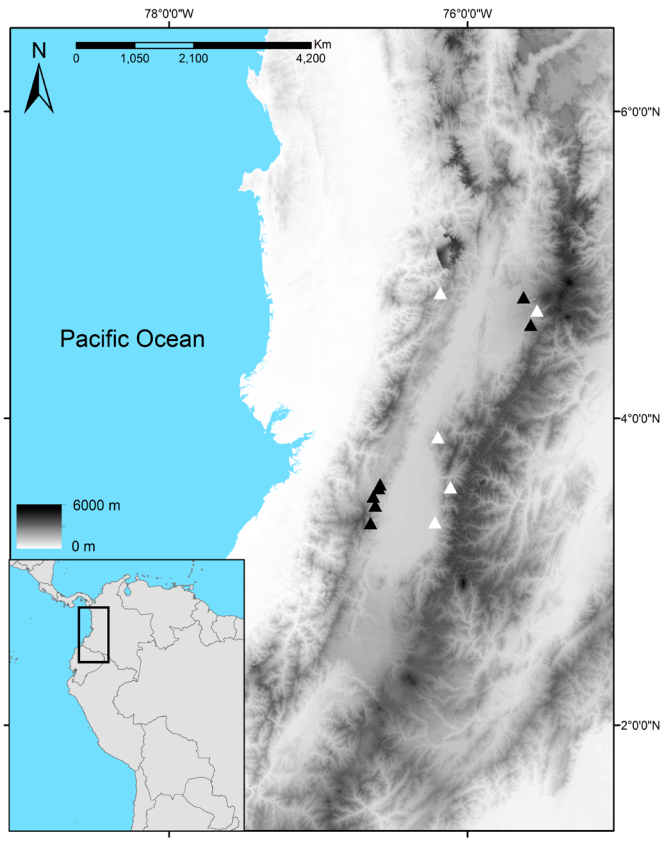

Figure 2. Collection localities of *Akodon affinis* in the Colombian Andes. White and black triangles depict localities where individuals showed traces or no traces of leucism, respectively.

Table 2. Proportion of leucism observed in populations of *Akodon affinis* throughout the years.

Andes	Locality	Year	*n*	Leucistic individuals	Proportion of leucism	Total per locality (n)
Central	Pereira	1989	7	0	0 %	10.53 % (19)
		1990	3	0	0 %	
		2013	9	2	22.22 %	
	Buga	2001	2	1	50.00 %	14.29 % (7)
		2004	5	0	0 %	
	Florida	1983	9	5	55.56 %	23.08 % (26)
		1989	5	0	0 %	
		1992	12	1	8.30 %	
	Palmira	2000	4	1	25.00 %	25.00 % (4)
Western	El Cairo	1984	3	0	0 %	10.00 % (10)
		2001	3	0	0 %	
		2002	4	1	25.00 %	

leucism traits occur with different frequency in both sexes and with different prevalence in the localities we studied, we consider that leucism in *A. affinis* may be due to genetic factors.

Considering the effects of geographic isolation in the emergence of recessive traits (*e. g.,* bottleneck effect; Bensch *et al.* 2000; Lopucki and Mróz 2010), our findings suggest that some populations of *A. affinis* might be experiencing inbreeding due to either the discontinuous distribution of this species (Roach 2016) or to habitat fragmentation in the Colombian Andes (Kattan *et al.* 1994; Kattan and Alvarez-López 1996). According to the International Union for Conservation of Nature (IUCN), *A. affinis* is listed as Least Concern since a large population is presumed from its wide overall distribution range (Roach 2016). Nevertheless, aside from its distribution, there is scarce information about the population ecology of this species (Pardiñas *et al.* 2015). Consequently, information on population dynamics and population genetics is needed to determine the conservation status of *A. affinis*.

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Appendix 1

Specimens of *Akodon affinis*, from the Mammals Collection of Universidad del Valle (UV) examined in this study. Specimens marked with an asterisk (*) show traces of leucism.

Central Andes

Quindío: Reserva Natural La Patasola, Municipality Salento 4° 39′ 32′′ N, -75° 34′ 37′′ W (UV13267, UV13268, UV13458)**. Risaralda:** Parque Regional Natural Ucumarí, Municipality Pereira, 4° 42′ 7.4′′ N, -75° 32′ 05.5′′ W, 2,130 m (UV10323 ♂, UV10324 ♂, UV10325 ♂, UV10326 ♂, UV10327 ♂, UV10328 ♂, UV10329 ♀, UV10330 ♀, UV10331 ♀, UV10332 ♀, UV14437 ♂, UV14438 ♀, UV14439 ♂, UV14440 ♂*, UV14466 ♀, UV14467 ♀, UV14468 ♀, UV14487 ♀, UV14488*♂); Finca La Selva, vereda El Cedralito, Municipality Santa Rosa de Cabal, 4° 47′ 18′′ N, -75° 37′ 29′ 'W (UV3367 ♀, UV13052 ♀, UV13053 ♂).

Valle del Cauca: Finca Venteaderos, Vereda La Nevera, Municipality Palmira, 3° 33′ 02′′ N, -76° 06′ 51′ 'W, 2,700m (UV12022 ♂, UV12023 ♂, UV12024 ♀, UV12025 ♂*); Finca Santelina, Vereda El Janeiro, Corregimiento La Habana, Municipality Buga, 3° 52′ 37′′ N, -76° 11′ 57′′ W, 1800 m (UV12413 ♂, UV12414 ♂*, UV13027 ♂, UV13028 ♂, UV13029 ♀, UV13030 ♀, UV13031♀); Hacienda Los Alpes, Vereda Las Brisas, Municipality Florida, 3° 19′ 18′′ N, -76° 13′ 07′′ W, 2,400 m (UV3570 ♂*, UV3571 ♂*, UV3572 ♂, UV3573 ♂*, UV3574 ♂, UV3575 ♂*, UV3576 ♂, UV3577 ♀, UV3578 ♀*, UV10335 ♂, UV10336 ♂, UV10337 ♀, UV10338 ♀, UV10339 ♀, UV10343 ♂, UV10344 ♂, UV10345 ♀, UV10346 ♀, UV10347 ♀, UV10512 ♂, UV10513 ♂, UV10514 ♂, UV10515 ♀, UV10867 ♂*, UV10868 ♀, UV10869 ♀).

Western Andes

Valle del Cauca: Campamento Corea, Parque Nacional Natural Farallones de Cali, Municipality Cali, 3° 19′ N, -76° 39′ W (UV2261 ♂, UV2589 ♂, UV2590 ♀, UV2591 ♀, UV4385 ♂); Torre de televisión, Cerro La Horqueta, Municipality Cali, 03° 29′ 25′′ N, -76° 37′ 54′′ W, 2,250 m (UV8162 ♂, UV8163 ♂, UV8164 ♀, UV10333 ♂, UV10334 ♂, UV10517 ♂); Pichindé, Municipality Cali, 3° 25′ 52′′ N, -76° 37′ 6′′ W 1,800 m (UV6621 ♂, UV6622 ♂, UV6623 ♂, UV6624 ♂, UV6631 ♀, UV6632 ♀, UV10613 ♀); Parcelación El Silencio, vereda La Elvira, Municipality Cali, 3° 32′ 43′′ N, -76° 35′ 44′′ W, 2,000 m (UV14645 ♀, UV14652 ♂, UV 14653 ♂); Finca La Minga, Reserva forestal Bitaco, Vereda Chicoral, corregimiento Bitaco, Municipality La Cumbre, 3° 33′ 69′′ N, -76° 35′ 10.1′′ W, 1982 m (UV14774 ♂, UV14775 ♂, UV14780 ♂). Alto Galápagos, Municipality El Cairo, 4° 49′ 00′′ N, -76° 11′ 00′′ W, 2,000 m (UV4171 ♂, UV4172 ♀, UV4173 ♀, UV12334 ♂, UV12335 ♂, UV12336 ♀, UV12583 ♂, UV12584 ♂, UV13343 ♂*, UV13344♂).