

Leucistic Antarctic fur seal (*Arctocephalus gazella*) at Robert Island, South Shetland Islands, Antarctica, with a note on colour morph nomenclature

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Abstract Fur chromatic disorders, which include albinism, leucism and melanism, are rare in mammals. Worldwide these atypical cases are naturally infrequent and poorly reported in the literature, particularly in pinnipeds. The knowledge available about colouration in mammals comes from studies in mice and other domestic mammals. Generally this information is homologous to most mammals. However, adaptive interpretation of atypical colouration patterns in pinnipeds and its biological relevance are uncertain. Hence, this report is indirect evidence of a source of misunderstood genetic variability for this group of carnivores. Here, we present an opportunistic observation of leucism in an Antarctic Fur Seal, *Arctocephalus gazella*, from Peninsula Coppermine, in Robert Island, South Shetland Islands, Antarctica. A young male with a leucistic dilute phenotype was recorded on February 5th, 2013. This is the first confirmed record of a leucistic fur seal on this island. Additionally, we provide some general comments on the nomenclature used for colour morphs.

Keywords Leucism · Otariidae · Partial albinism · Piebaldism · Pinnipeds · Polar mammals

Introduction

Pinnipeds (seals, sea lions, and walruses) have relatively conservative and uniform colour patterns compared to other groups of vertebrates and even other mammals. However, substantial intra- and interspecific variation in coat colour has been reported in this group (Perrin 2009). Coat colour patterns in pinnipeds are generally understood as an adaptive expression related to evasion of predators, feeding, sexual selection and thermoregulation (Caro et al. 2012). Added to the range of natural colour variations are occurrences of albinism, leucism or melanism (Acevedo et al. 2009). These atypical conditions have a congenital origin as a consequence of mutations affecting the generation, distribution and aggregation of the pigment melanin in either of its two forms: eumelanin and pheomelanin (Lamoreux et al. 2010). In pinnipeds, these abnormal cases are naturally uncommon and poorly reported in the literature (Table 1).

The knowledge available about colouration in mammals comes from studies of domestic mammals (Cieslak et al. 2011), especially mice (Lamoreux et al. 2010). Generally this information is homologous to most mammals. However, adaptive interpretation of atypical colouration patterns in pinnipeds and its biological relevance are uncertain. Hence, this kind of report as indirect evidence of a misunderstood source of genetic variability is significant for this group of carnivores.

The Antarctic fur seal (*Arctocephalus gazella*) shows a marked sexual dimorphism in both size and colouration. Adult males range in length up to 200 cm and weight up to 200 kg, in contrast with females with lengths up to 145 cm and weights up to 50 kg (Laws 2009). Out of the water, adult males have a dark grey to blackish coat, grizzled on the sides and mane, while in

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Table 1 Atypical coloration records in Pinnipeds

	Source
Sea lions and fur seals (Otariids)	
Antarctic fur seal, <i>Arctocephalus gazella</i>	Acevedo et al. (2009) Aguayo (1978) Aguayo and Torres (1967) Bonner (1958, 1968) Budd (1972) Cárdenas and Yáñez (1983) De Bruyn et al. (2007) Hofmeyr et al. (2005) Øristland (1960) Rayner and Etheridge (1933) cited by Bonner (1968) Reeves et al. (1992) Vaughan (1963) cited by Bonner (1968) Wege et al. (2015)
Northern fur seal, <i>Callorhinus ursinus</i>	Fomin et al. (2012) King (1983) Marakov (1974) cited in Fomin et al. (2012) Scheffer (1962)
Steller's sea lion, <i>Eumetopias jubatus</i>	King (1983) Loughlin et al. (1987)
California sea lion; <i>Zalophus californianus</i>	Abreu et al. (2013) Bartholomew and Hubbs (1952) Acevedo and Aguayo (2008)
Southern sea lion; <i>Otaria flavescens</i>	
Seals (Phocids)	
Harbour seal, <i>Phoca vitulina</i>	Osinga et al. (2010)
Southern elephant seal, <i>Mirounga leonina</i>	Aguayo et al. (1995) Bester et al. (2008) Bried and Haubrex (2000) Reisinger et al. (2009)
We do not know any record for walruses	

females and subadults, the fur varies from grey to brown and may be paler with ruddy brown shades (Fig. 1, Weber 2014). Usually the pelage of pups is black with some pale areas on the head until the first moult, after which the pelage adopts the female adult colouration. Less than 1% of newborns are white at birth and remain whitish for life, with lack of pigmentation in the coat and normally brown colouration only in the ears, eyes, flippers and nose (Forcada and Staniland 2009).

Here we report the first case of leucism in an Antarctic Fur Seal, *A. gazella*, from Peninsula Coppermine (62°22'46"S, 59°42'07"W), in the western end of the Robert Island, South Shetland Islands, Antarctica. We also provide some general comments on the nomenclature used for colour morphs.



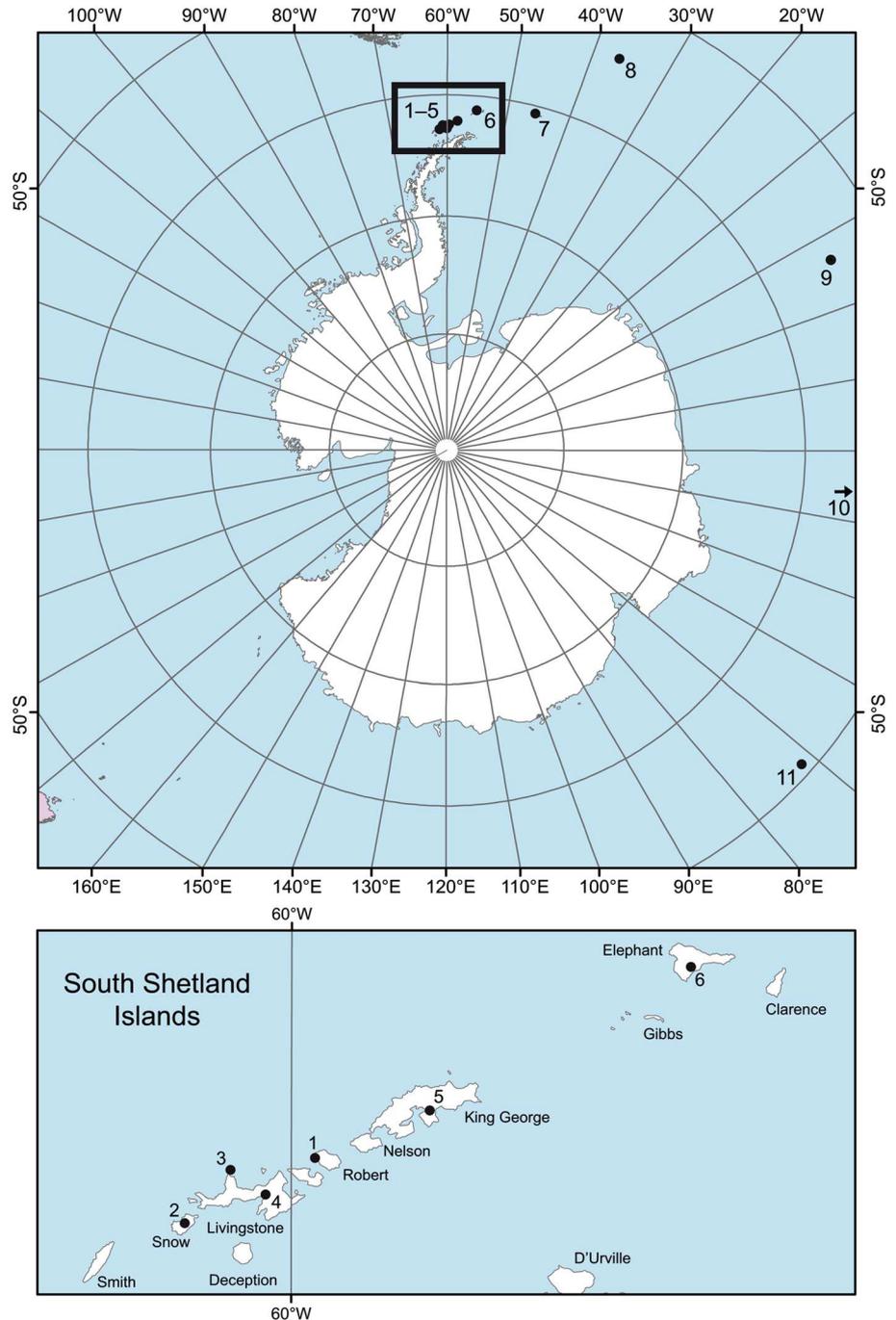
Fig. 1 Normally coloured Antarctic fur seal (*Arctocephalus gazella*) adult male at Robert Island, South Shetland Islands, Antarctica, in February 24th, 2012. Photograph credit: Diego G. Tirira

Materials and methods

Our observation was made during a pinnipeds monitoring project that was carried out on five Antarctic islands (Robert, Greenwich, Dee, Aitcho, and Cecilia) from summer 2010 to summer 2014 by Diego Tirira (see also Tirira 2015). However, this record is an opportunistic observation. No specific field effort or experimental design was associated with the observation we report.

This record comes from Peninsula Coppermine ($62^{\circ}22'46''\text{S}$, $59^{\circ}42'07''\text{W}$), in the western end of Robert Island, South Shetland Islands, Antarctica (Fig. 2). The location is a few metres north of the Chilean Risopatrón Base and 9 km north of the Ecuadorian Scientific Maldonado Base ($62^{\circ}27'36''\text{S}$, $59^{\circ}44'54''\text{W}$).

Fig. 2 Above: worldwide records of leucistic individuals of Antarctic fur seal (*Arctocephalus gazella*). Below detail of South Shetland Islands. Black dots represent the localities mentioned in this study: 1 Robert Island ($62^{\circ}22'\text{S}$, $59^{\circ}42'\text{W}$), this study; 2 Snow Island ($62^{\circ}46'\text{S}$, $61^{\circ}23'\text{W}$), Aguayo (1978); 3 Livingston Island, Cape Shirreff and San Telmo Islets ($62^{\circ}27'\text{S}$, $60^{\circ}47'\text{W}$), Acevedo et al. (2009); 4 Livingstone Island ($62^{\circ}36'\text{S}$, $60^{\circ}20'\text{W}$), Cardenas and Yáñez (1983); 5 King George ($62^{\circ}05'\text{S}$, $58^{\circ}15'\text{W}$), Cardenas and Yáñez (1983); 6 Elephant Island ($61^{\circ}08'\text{S}$, $55^{\circ}07'\text{W}$), Aguayo and Torres (1967); 7 South Orkney Islands ($60^{\circ}35'\text{S}$, $45^{\circ}30'\text{W}$), Øristland (1960); 8 South Georgia Islands ($54^{\circ}17'\text{S}$, $36^{\circ}30'\text{W}$), Bonner (1958, 1968), Reeves et al. (1992); 9 Bouvetøya Island ($54^{\circ}25'\text{S}$, $03^{\circ}20'\text{E}$), Hofmeyr et al. (2005); 10 Marion Island ($46^{\circ}56'\text{S}$, $37^{\circ}52'\text{E}$), De Bruyn et al. (2007), Wege et al. (2015); 11 Heard Island ($53^{\circ}06'\text{S}$, $73^{\circ}31'\text{E}$), Budd (1972)



Results and discussion

On February 5th, 2013 we recorded an apparently healthy young male with a uniformly creamy and full white coat, except the ear tips, eyes, nose and flippers that retained the normal dark brown colouration; the vibrissae of the muzzle and eyebrows were also creamy (Fig. 3).

Few records and a very low ratio of leucistic individuals have been reported for the South Shetland Islands. Aguayo (1978) reported only two cases among more than 4000 individuals counted on nine of the South Shetland Islands, one he observed on Snow Island and the other was reported by Aguayo and Torres (1967) on Elephant Island. Cardenas and Yáñez (1983) reported only three subadults with this phenotype among 412 individuals of *A. gazella* counted on King George and Livingstone islands. Acevedo et al. (2008) reported four “rare light-coloured (partially leucistic) pups”, include one with a “piebald” phenotype on Livingston Island. Other individuals with this phenotype have been reported out of the South Shetland Islands to Bouvetøya Island (2 records; Hofmeyr et al. 2005); Marion Island (3 records; De Bruyn et al. 2007; Wege et al. 2015); South Georgia Island (25 records; Bonner 1958, 1968; Reeves et al. 1992); South Orkney Islands (1 record; Øristland 1960; Fig. 2).

In mammals, white or creamy colouration is formally recognized as the dilute phenotype (Lamoreux et al. 2010), a hypomelanistic type that is consequence of a failure in the transport process of the melanosomes (a specialized pigment organelle) into the pigmentary cell cytoplasm (the mammalian melanocyte), from which they are deposited into the keratinocytes, in the epidermis or the growing hair. Leucism is a general term that can be used to refer to this

condition (Fertl and Rosel 2009), but with the proviso that there is another condition, the spotted phenotype, which also could be considered leucism. The spotted phenotype it is a consequence of mutations affecting the viability of the melanocytes in some areas of the body. This phenotype has been referred to in some reports as piebaldism. However, we think that nomenclature based on a mutated gene commonly employed to describe this phenotype is misused. Piebald is only one of the plethora of mutations that produce spotted phenotypes (Zalapa et al. 2016), so the visual evaluation of an individual with the spotted phenotype hardly allows observers to differentiate genetic mutation that gave rise to this phenotype. Another misused name commonly employed in the literature to refer to a leucistic phenotype is partial albinism. In fact, albinism is the consequence of a mutation that affects a different stage of the melanin metabolic pathway (i.e. melanogenesis; Lamoreux et al. 2010). Albinistic mammals are incapable of making normal melanosomes (Lamoreux et al. 2010). On this condition the affected individual totally lacks melanin in the skin, hairs and eyes. Note that in this context by definition the albinistic condition cannot be partial. Consequently, we recommend abrogating the use of the terms partial albinism and piebaldism, in favour of and retaining leucism as a general nominative term that includes both the diluted and the spotted phenotypes.

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Fig. 3 Leucistic Antarctic fur seal (*Arctocephalus gazella*) young male at Robert Island, South Shetland Islands, Antarctica, in February 5th, 2013. Photograph credit: Rosa Jijón

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