



Anomalous lanugo coat colourations in sub-Antarctic fur seal (*Arctocephalus tropicalis*) pups born on Marion Island

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Abstract

Anomalous pelage colourations are not uncommon amongst pinnipeds but have not been documented in sub-Antarctic fur seals (*Arctocephalus tropicalis*). Fur seals (*Arctocephalus* spp.) have been monitored on Marion Island since 1973, and as part of the long-term monitoring programme, any atypical sightings of fur seals were recorded. Fourteen sub-Antarctic fur seal pups with anomalous lanugo coat colourations were observed on Marion Island between 2008 and 2018. Most of these pups were born to typically coloured sub-Antarctic fur seal mothers. The observed coat colourations are an anomaly of their natal (lanugo) black coats. While all pups had normal colour vibrissae and eyes, they had creamy muzzles and brown-to-blond ventral and belly colouration. The fur on the flippers was a light tan to cream in colouration, darkening towards the border of the flipper. The dorsal side of the pups all appeared to be light grey in colour. All pups appeared to be healthy. Once moulted, these pups had normal adult pelage colourations. The frequency of occurrence of these anomalous lanugo coat colourations was low, suggesting that this is a particularly rare phenomenon. The causes for these anomalous coat colourations are unknown. These observations are the first records of sub-Antarctic fur seal pups with anomalous lanugo fur colourations from the Prince Edward Islands and represents the first of such observations in sub-Antarctic fur seals worldwide. It also represents the first report on anomalous colourations of pinnipeds that appears to exclusively influence the lanugo fur.

Keywords Sub-Antarctic fur seal · *Arctocephalus tropicalis* · Marion Island · Anomalous coat colouration

Introduction

Atypical colouration (leucism, albinism, piebald etc.), can occur when mammals have too much, or too little of a certain colour pigment in some, or all parts of the body (Acevedo and Aguayo 2008). Leucism occurs when individuals

have ‘partial’ or ‘total’ loss of pelage pigmentation but differs from albinism in that animals retain normal eye and body extremity colouration (Fertl and Rosel 2009). Leucism has been recorded in a number of pinniped species, including Antarctic fur seal *Arctocephalus gazella* adults (Hofmeyr et al. 2005; de Bruyn et al. 2007; Hoffman et al. 2018) and pups (Bonner 1968; Wege et al. 2015; Peters et al. 2016), southern elephant seals *Mirounga leonina* (Bester et al. 2008; Reisinger et al. 2009) and the South American sea lion *Otaria flavescens* (Acevedo and Aguayo 2008). Piebald, tiger-like, tricolour and brown colour morphs have also been observed in Antarctic fur seals (Acevedo et al. 2009), and numerous ‘white’ Antarctic fur seals have been observed on South Georgia (Bonner 1968). There have been no documented cases of anomalous pelage colourations in adult or pup sub-Antarctic fur seals (*Arctocephalus tropicalis*).

Lanugo fur is the soft, fine hair covering most mammalian fetuses (Riedman 1990). In pinnipeds, it can be shed before birth or retained after a pup is born (Riedman 1990). Sub-Antarctic fur seals are usually born between early

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December and January with thick black lanugo (natal) fur that is then moulted at approximately three months of age (Kerley 1983). We observed 14 sub-Antarctic fur seal pups

with anomalously coloured natal fur (Table 1) on Marion Island (46°52'S, 37°51'E) in the Southern Indian Ocean (Fig. 1). The colouration of their coats resembled that of

Table 1 Between January 2008 and January 2018, 14 anomalously coloured sub-Antarctic fur seal (*Arctocephalus tropicalis*) pups sighted on Marion Island

Sighting number	Date	Sex	Name of beach	Coordinates	Notes on how pups were inspected
1	25/01/2008	Unknown	Duikers Point	46°51'36"S, 37°51'14.4"E	Sighted and photographed
2	10/01/2009	Female	Rockhopper Bay	46°52'12"S, 37°51'25.2"E	Sighted, handled and photographed
3	??/01/2010	Unknown	Outcrop Beach	46°49'29.44"S, 37°41'58.96"E	Sighted
4	07/02/2011	Unknown	Mixed Pickle Cove	46°52'19.2"S, 37°38'13.2"E	Sighted and photographed
5	27/01/2012	Unknown	Sealers South Beach	46°50'52.8"S, 37°49'44.4"E	Sighted and photographed
6	??/01/2012	Female	Rockhopper Bay	46°52'26.83"S, 37°51'27.75"E	Sighted and handled
7	??/01/2012	Male	near King Penguin Bay	46°50'20.39"S, 37°48'14.53"E	Sighted and handled
8	??/01/2012	Female	Fur Seal Peninsula	46°52'16.74"S, 37°38'08.17"E	Sighted and handled
9	18/01/2016	Male	Cape Davis Sealers Beach	46°49'26.4"S, 37°41'45.6"E	Sighted, handled and photographed
10	18/01/2016	Male	Cape Davis Sealers Beach	46°49'26.4"S, 37°41'45.6"E	Sighted, handled and photographed
11	18/01/2016	Female	Cape Davis Sealers Beach	46°49'26.4"S, 37°41'45.6"E	Sighted, handled and photographed
12	18/01/2016	Female	Cape Davis Sealers Beach	46°49'26.4"S, 37°41'45.6"E	Sighted, handled and photographed
13	19/01/2016	Female	Ships Cove	46°51'21.6"S, 37°50'38.4"E	Sighted, handled and photographed
14	??/01/2018	Male	Sealers South Beach	46°50'52.8"S, 37°49'44.4"E	Sighted, handled and photographed

Refer to the supplementary material for photographs of the sightings (Online Resource 1)

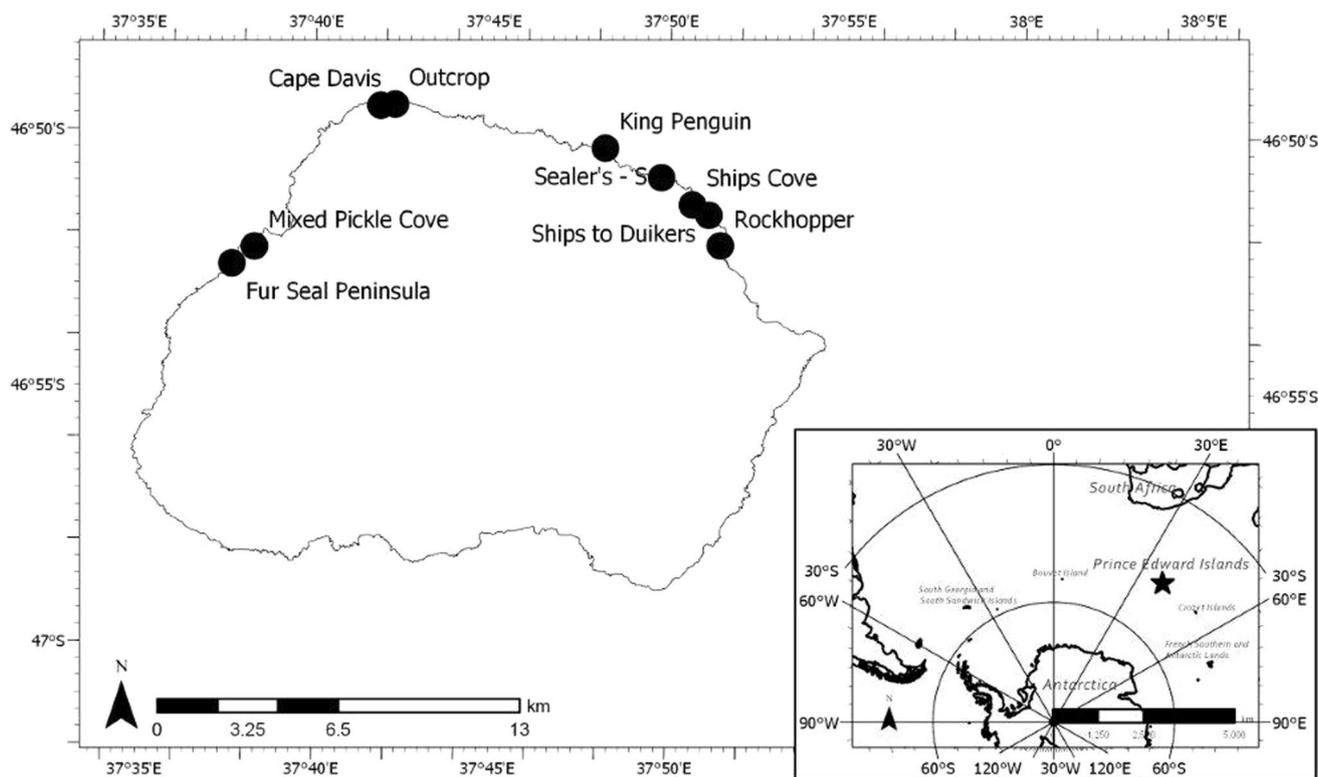


Fig. 1 Location of Marion Island (Price Edward Islands) and the beaches where sub-Antarctic fur seal (*Arctocephalus tropicalis*) pups with anomalous lanugo fur were sighted during 2008–2018

adult sub-Antarctic fur seals and, upon closer inspection in the field and from photographs, it was clear that the lanugo fur had yet to be moulted. This is the first documented report on anomalous pelage colourations of sub-Antarctic fur seals and in pinnipeds, which appear to exclusively influence the lanugo fur.

Materials and methods

Marion Island is the larger of the Prince Edward Islands located in the Southern Indian Ocean (Fig. 1). Fur seals (*Arctocephalus* spp.) and southern elephant seals have been monitored on Marion Island since 1973 (Bester et al. 2011). In 1983, the programme intensified so that more beaches were surveyed, and an intensive tagging programme began, thus increasing the pinniped monitoring around the island (Bester et al. 2011). Most beaches on the island are frequented monthly for pinniped monitoring (Kirkman et al. 2004; De Bruyn et al. 2007). During pinniped monitoring, field personnel would take note of any atypical seals and document these observations (Bester et al. 2011). If possible, photographs were taken, and additional information such as

sex, age and condition was collected. The information collected was often dependent on the accessibility of the individual sighted. This study reports on atypical sub-Antarctic fur seal sightings with anomalous pelage colourations.

Results and discussion

A total of 14 sub-Antarctic fur seal pups with anomalous pelage colourations were recorded at nine different sites around Marion Island between January 2008 and January 2018 (Fig. 1, Table 1). The sightings took place around the northern and western coastlines of the island, where > 80% of the island's breeding population reside (Wege et al. 2016). While all pups had normal colour vibrissae and eyes, they had creamy muzzles and brown to blonde ventral and belly colouration. The fur on the flippers was a light tan/cream darkening towards the border of the flipper. The dorsal side of the pups were light grey in colour (Figs. 2 and 3). All initial sightings occurred within two months of the pups being born (pre-moult stage). The individual in sighting two (Table 1) was born to a normal-coloured female (noticeable yellowish chest and face, greyish-brown

Fig. 2 **a** Anomalous lanugo coat in a sub-Antarctic fur seal (*Arctocephalus tropicalis*) pup born at Rockhopper bay on Marion Island during the austral summer of 2008/2009. **b** This same pup photographed next to a normal 'black' sub-Antarctic fur seal pup from the same cohort. Photograph credit: R. Reisinger

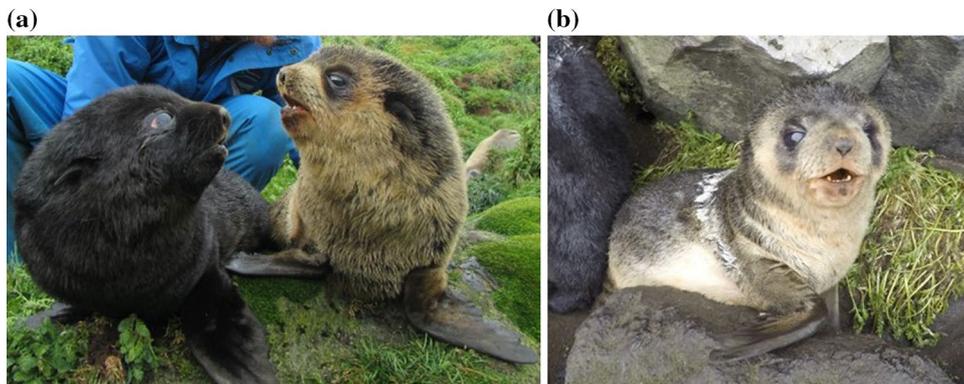
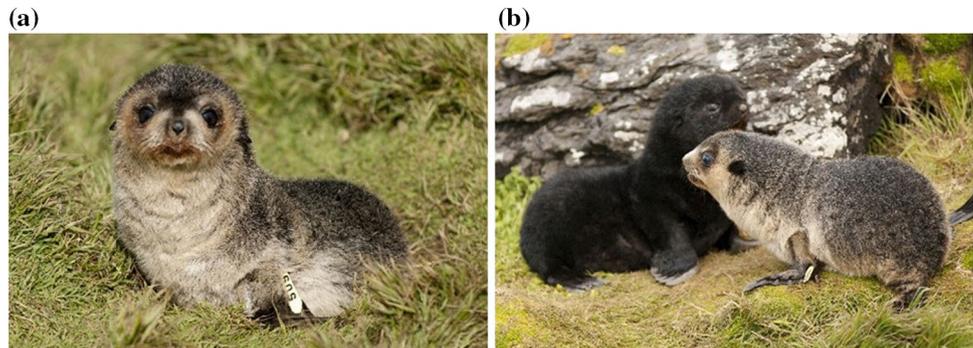


Fig. 3 **a** Anomalous lanugo coat in a sub-Antarctic fur seal (*Arctocephalus tropicalis*) pup (photographed next to a normal black pup) born at Cape Davis Sealers Beach on Marion Island during the austral summer of 2015/2016. **b** Individual b also born at Cape Davis Sealers

Beach during the austral summer of 2015/2016 (white markings on the back are due to a mark-recapture experiment and are not natural markings). Photograph credit: M. Mole

body with a ginger belly; King 1983). Both the pup and adult female were tagged and re-sighted on several occasions during the breeding season. Upon moulting, the pup resembled a normal sub-Antarctic fur seal pup. The pup weaned successfully but has not since been re-sighted. It is common for tagged pups never to be re-sighted, due to the naturally high mortality rates for underyearlings (Doidge et al. 1984; Mattlin 1978), as well as high rates of tag loss in fur seal juveniles (Testa and Rothery 1992; Wilkinson and Bester 1997; Bradshaw et al. 2000). The adult female was re-sighted and subsequently gave birth to normal-coloured pups in consecutive years (2011, 2012, and 2013). Sightings three, six, seven and eight were also sighted with normal-coloured mothers. None of the other pups (sightings one, four, five, and 9–14) were seen suckling with their mothers, so it is unclear if the mothers were normal in colouration. Whether these pups weaned or not is also unknown. Anomalous lanugo hair was present in both male and female pups (Table 1). The pups were all healthy and not obviously disadvantaged.

Fur seal populations are monitored extensively on Marion Island as part of the Marine Mammal Programme (Bester et al. 2011) and as such it is likely that any unusual sightings such as these reported, are well documented. Over 8000 sub-Antarctic fur seal pups are born annually on the island (Wege et al. 2016), suggesting that the observed anomalous coat colourations are a rare phenomenon, particularly when one considers that no more than five anomalous coloured pups were seen in any one year. These observations are the first records of sub-Antarctic fur seal pups with anomalous lanugo fur colourations from the Prince Edward Islands and represents the first of such observations in sub-Antarctic fur seals worldwide. These observations are most like the partially leucistic, tricolour morph documented in the Antarctic fur seal pup at Cape Shirreff (Acevedo et al. 2009). However, the fur texture of the tricolour morph was thicker than that of normal pups—the fur was light brown with patches of light brown also present on the flanks and back, which is typical of a hypo-pigmentation pattern. The fur coats of our 14 sub-Antarctic fur seals pups had the same texture and thickness as that of normal coloured pups, and the fur lacked any patchiness, but rather resembled their adult pelage. The main difference, however, is that the tricolour morph pups would have remained colour morphs once moulted (Acevedo et al. 2009), whilst the anomalous lanugo fur pups (this study) looked like normal-coloured adults once they had moulted. The causes for these anomalous lanugo coat colourations are relatively unknown; if similar to leucism, piebald or albinism, then some scientists suggest that the causes could be due to changes in melanocyte development which alters the spatial distribution of pigmentation across the body, or along individual hairs (Hoekstra 2006).

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Compliance with ethical standards

Conflict of interest We declare that there are no conflicts of interest (financial or non-financial) with regard to this research or this paper.

Ethical approval All Marion Island Marine Mammal work has ethics clearance from the Animal Ethics Committee of the Faculty of Veterinary Science, University of Pretoria, under AUCC 040,827-022, AUCC 040,827-023, AUCC 040,827-024 and EC030602-016, and is carried out under permit granted by the Director-General: Department of Environmental Affairs, South Africa. The Marion Island Marine Mammal Programme field protocol workplan (De Bruyn et al. 2018) as approved by the Director General of the Department of Environmental Affairs and the guidelines for fieldwork with marine mammals as published by the Society for Marine Mammalogy (Gales et al. 2009) were followed.

References

- Acevedo J, Aguayo M (2008) Leucistic South American sea lion in Chile, with a review of anomalously color in otariids. *Rev Biol Mar Oceanogr* 43:413–417
- Acevedo J, Torres D, Aguayo-Lobo A (2009) Rare piebald and partially leucistic Antarctic fur seals, *Arctocephalus gazella*, at Cape Shirreff, Livingston Island, Antarctica. *Polar Biol* 32:41–45
- Bester MN, de Clercq H, Hofmeyr GJG, de Bruyn PJN (2008) Leucistic southern elephant seal at Marion Island? *Polar Biol* 31:255–257
- Bester MN, De Bruyn PJN, Oosthuizen WC, Tosh CA, McIntyre T, Reisinger RR, Postma M, Van der Merwe DS, Wege M (2011) The marine mammal programme at the Prince Edward islands: 38 years of research. *Afr J Mar Sci* 33:511–521
- Bonner WN (1968) *The fur seal of South Georgia*. Scientific Reports, No. 56. British Antarctic Survey, London
- Bradshaw CJA, Barker RJ, Davis LS (2000) Modeling tag loss in New Zealand fur seal pups. *J Agric Biol Environ Stat* 5:475–485
- De Bruyn PJN, Pistorius PA, Tosh CA, Bester MN (2007) Leucistic Antarctic fur seal at Marion Island. *Polar Biol* 30:1355–1358
- De Bruyn PJN, Oosthuizen WC, Bester MN (2018) Marion Island Marine Mammal Programme: procedures and guidelines for seal research at Marion Island. Unpublished, Mammal Research Institute, University of Pretoria, p 98
- Doidge DW, Croxall JP, Baker JR (1984) Density-dependent pup mortality in the Antarctic fur seal *Arctocephalus gazella*. *J Zool* 202:449–460
- Fertl D, Rosel PE (2009) Albinism. In: Perrin WF, Würsig B, Thewissen JGM (eds) *Encyclopedia of marine mammals*, 2nd edn. Academic Press, San Diego, pp 24–26
- Gales NJ, Bowen WD, Johnston DW, Kovacs KM, Littnan CL, Perrin WF, Reynolds JE III, Thompson PM (2009) Guidelines for the treatment of marine mammals in field research. *Mar Mammal Sci* 25:725–736
- Hoekstra HE (2006) Genetics, development and evolution of adaptive pigmentation in vertebrates. *Heredity* 97:222–234
- Hoffman JI, Bauer E, Pajmans AJ, Humble E, Beckmann LM, Kubetschek C, Christaller F, Kröcker N, Fuchs B, Moreras A, Shihlomule YD, Bester MN, Cleary AC, De Bruyn PJN, Forcada J, Goebel ME, Goldsworthy SD, Guinet C, Hoelzel AR, Lydersen

- C, Kovacs KM, Lowther A (2018) A global cline in a colour polymorphism suggests a limited contribution of gene flow towards the recovery of a heavily exploited marine mammal. *R Soc Open Sci* 5:1–9
- Hofmeyr GJG, Bester MN, Kirkman SP (2005) Leucistic Antarctic fur seals at Bouvetøya. *Polar Biol* 29:77–79
- Kerley GIH (1983) Comparison of seasonal haul-out patterns of fur seals *Arctocephalus tropicalis* and *A. gazella* on subantarctic Marion Island. *S Afr J Zoo* 13:71–77
- King JE (1983) Seals of the world. Oxford University Press, Oxford
- Kirkman SP, Bester MN, Hofmeyr GJG, Jonker FC, Pistorius PA, Owen R, Strydom N (2004) Variation in the timing of the breeding haul-out of female southern elephant seals at Marion Island. *Aust J Zool* 52:379–388
- Mattlin RH (1978) Pup mortality of the New Zealand fur seal *Arctocephalus forsteri lesson*. *New Zeal J Ecol* 1:138–144
- Peters L, Humble E, Kröcker N, Fuchs B, Forcada J, Hoffman JI (2016) Born blonde: a recessive loss-of-function mutation in the melanocortin 1 receptor is associated with cream coat coloration in Antarctic fur seals. *Ecol Evol* 6:5705–5717
- Reisinger RR, Mufanadzo NT, De Bruyn PJN, Bester MN (2009) Leucistic southern elephant seal at Marion Island. *Polar Biol* 32:509–511
- Riedman M (1990) The pinnipeds: seals, sea lions and walruses. The University of California Press, Berkeley, pp 107–350
- Testa JW, Rothery P (1992) Effectiveness of various cattle ear tags as markers for Weddell seals. *Mar Mammal Sci* 8:344–353
- Wege M, Postma M, Tosh CA, De Bruyn PJN, Bester MN (2015) First confirmed record of a leucistic Antarctic fur seal pup born outside the Scotia Arc Islands. *Polar Biol* 38:569–571
- Wege M, Etienne M-P, Oosthuizen WC, Reisinger RR, Bester MN, De Bruyn PJN (2016) Trend changes in sympatric Subantarctic and Antarctic fur seal pup populations at Marion Island, Southern Ocean. *Mar Mammal Sci* 32:960–982
- Wilkinson IS, Bester MN (1997) Tag-loss in southern elephant seals, *Mirounga leonina*, at Marion Island. *Antarct Sci* 9:162–167

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