

# Plumage aberrations in Macaroni Penguins *Eudyptes chrysolophus* at sub-Antarctic Marion Island

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**Abstract** Plumage aberrations, such as leucism, isabellinism, albinism and melanism, are hereditary and are caused by irregularities in the formation of melanin. This paper presents opportunistic observations of plumage aberrations in 15 Macaroni Penguins *Eudyptes chrysolophus* at sub-Antarctic Marion Island during 2008–2016. Across five colonies, full and partial leucism, isabellinism and partial melanism were recorded. Plumage aberration in Macaroni Penguins is rarely reported elsewhere in the world. The relatively high number of recorded individuals at Marion Island, in conjunction with limited mixing between global Macaroni Penguin colonies, suggests that a relatively high proportion of the population is entrained with this genetic predisposition.

**Keywords** *Eudyptes chrysolophus* · Macaroni Penguin · Plumage aberrations · Spheniscidae

## Introduction

The coloration of a birds' plumage is determined by two pigments: carotenoids and melanins (Fox and Vevers 1960). Carotenoids are responsible for light yellow to red

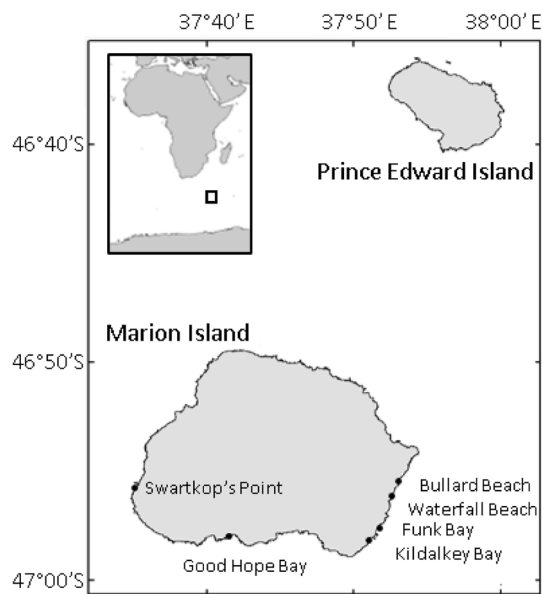
scarlet colouration and are synthesized from substances in the diet. Melanins are responsible for black, grey, dark brown or reddish brown feathers. The formation of melanin is a genetic process that requires a series of chemical reactions involving the oxidation of tyrosine catalysed by tyrosinase (van Grouw 2006, 2013). Any irregularity during the formation of melanin influences the colour of the plumage resulting in aberrations (van Grouw 2006, 2013). Irregularities include, but are not limited to, a change in intra-cellular conditions which may lead to change in the outcome of melanin production, a change in the distribution of colour cells or a mutation in the formation of tyrosinase which may impede or inhibit the formation of melanin (van Grouw 2006). Commonly reported aberrations in seabirds includes: leucism, isabellinism, albinism and melanism (e.g. Blight and Stevens 2000; Forrest and Naveen 2000; Voisin et al. 2002; Oosthuizen and de Bruyn 2009).

A leucisitic individual is able to normally produce melanin, however, the deposition of melanin in feathers is disrupted, resulting in full or partial white plumage (van Grouw 2006; Nogueira and Alves 2011). The feathers of an isabelline individual are uniformly lightened due to a form of pigment dilution that reduces the concentration of melanin in feathers (Everitt and Miskelly 2003). An albino individual lacks tyrosinase within their body and as a result has no melanin pigmentation in feathers, skin or eyes (Mahabal et al. 2016). In contrast, a melanistic individual has an abnormal amount of melanin and is fully or partially black (Blight and Stevens 2000; van Grouw 2006). The aim of this paper is to present all observed plumage aberrations in Macaroni Penguins *Eudyptes chrysolophus* at Marion Island between 2008 and 2016.

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**Fig. 1** Location of the Prince Edward Archipelago, which consists of Marion and Prince Edward islands, in relation to Africa and Antarctica. Locations of colonies where Macaroni Penguins *Eudyptes chrysolophus* with plumage aberrations were observed from 2008 to 2016 and historically are indicated

## Materials and methods

The Prince Edward Archipelago is in the Indian sector of the Southern Ocean and comprises Marion and Prince Edward islands (Fig. 1). In 2008, the last published count, Marion Island supported 290,000 (Crawford et al. 2009) out of the approximately 6.3 million breeding pairs of Macaroni Penguins globally (Crossin et al. 2013). The island's population is divided into 53 colonies, the largest being at Kildalkey Bay and Bullard Beach. In 2003, when the island population was approximately 350,000 breeding pairs, these two colonies supported approximately 181,000 and 145,000 breeding pairs, respectively (Crawford et al. 2003, 2009).

Macaroni Penguins with plumage aberrations were opportunistically recorded by field personnel stationed at Marion Island between 2008 and 2016. During these observations, birds were photographed and details, such as date, location and, if known, breeding status, were recorded.

**Table 1** List of opportunistically recorded Macaroni Penguins *Eudyptes chrysolophus* with plumage aberrations at sub-Antarctic Marion Island 2008–2016 and historically. See Fig. 1 for colony locations

Date	Location	Plumage aberration	Breeding status	Reference
<b>New observations</b>				
05/11/2008	Bullard Beach	Partial leucism	Unknown	Fig. 2a
16/11/2008	Kildalkey Bay	Isabellinism	Unknown	Fig. 2b
21/11/2008	Bullard Beach	Partial leucism	Incubating	Fig. 2c
30/11/2009	Kildalkey Bay	Isabellinism	Incubating	Fig. 2d
30/11/2009	Kildalkey Bay	Partial melanism	Unknown	Fig. 2e
24/11/2010	Bullard Beach	Partial leucism	Incubating	Fig. 2f
29/11/2013	Waterfall Beach	Isabellinism	Incubating	Fig. 2g
30/11/2013	Bullard Beach	Partial leucism	Incubating	Fig. 2h
30/11/2013	Bullard Beach	Full leucism	Incubating	Fig. 2i
08/01/2014	Swartkop's Point	Isabellinism	Unknown	Fig. 2j
08/01/2014	Swartkop's Point	Partial leucism	Unknown	Fig. 2k
23/01/2014	Swartkop's Point	Partial leucism	Unknown	Fig. 2l
26/11/2015	Kildalkey Bay	Partial leucism	Incubating	Fig. 2m
04/12/2015	Funk Bay	Partial leucism	Brooding	Fig. 2n
23/01/2016	Bullard Beach	Partial leucism	Unknown	Fig. 2o
<b>Historical observations</b>				
2/12/1986	Kildalkey Bay	Partial leucism	Unknown	<sup>a</sup>
24/11/1993	Kildalkey Bay	Partial leucism	Breeding	<sup>b</sup>
11/03/1994	Swartkop's Point	Partial leucism	Moulting	<sup>b</sup>
08/12/1993, 23/01/1994, 11/03/1994	Swartkops Point	Partial leucism	Unknown but was later seen moulting	<sup>b</sup>
22/02/1994, 09/03/1994	Good Hope Bay	Albinism	Unknown but was later seen moulting	<sup>b</sup>

<sup>a</sup>Gartshore (1987)

<sup>b</sup>Van Wyk (1995)



**Fig. 2** Macaroni Penguins *Eudyptes chrysolophus* observed between 2008 and 2016 at sub-Antarctic Marion Island with plumage aberrations. See Table 1 for date, location, breeding status and description

of plumage aberration. The plumage aberrations of each penguin was described as follows, partial leucism (a, c, f, h, k–o), isabellinism (b, d, g, j), partial melanism (e) and full leucism (i)

## Results

Overall, 15 Macaroni Penguins with plumage aberrations were reported between 2008 and 2016 within five

colonies around Marion Island (Table 1; Fig. 2). Four types of plumage aberrations were identified, namely partial leucism, full leucism, partial melanism and isabellinism. Birds were mainly sighted on the east coast of

the island, with few sightings on the west coast (Fig. 1; Table 1).

## Discussion

This paper presents new observations of plumage aberrations in Macaroni Penguins at Marion Island. Previously, there have been observations of one albino and four partially leucistic Macaroni Penguins at the island (Table 1; Gartshore 1987; van Wyk 1995). However, authors incorrectly recorded the partially leucistic penguins as “partially albinistic” (Gartshore 1987; van Wyk 1995). Albinism is defined by a complete lack of tyrosinase and, therefore, an individual cannot be “partially albinistic” (van Grouw 2006). Plumage aberrations in other species observed on the island include one melanistic (B. M. Dyer pers. obs) and four isabelline King Penguins *Aptenodytes patagonicus* (Gartshore 1987; van Wyk 1995; Oosthuizen and de Bruyn 2009), one partially leucistic King Penguin and one partially leucistic Rockhopper Penguin *Eudyptes chrysocome* (van Wyk 1995).

Plumage aberrations are rare in penguins (Everitt and Miskelly 2003). To our knowledge there is only one record of plumage aberrations in Macaroni Penguins from elsewhere, and that was of an isabelline individual at Heard Island (Downes et al. 1959). The relatively large number of observations of plumage aberrations in Macaroni Penguins at Marion Island since 1986 (this study compared to Gartshore 1987 and; van Wyk 1995) is probably a function of increased research focus on seabirds during the latter period. Of the 15 penguins observed during this study, eight were breeding, indicating that the respective conditions are entrenched in the population. Although birds carrying these genetic mutations may have immigrated into the population, this seems unlikely. The Crozet Archipelago supports a significant proportion of the Macaroni Penguin global population (approximately 1,812,000 pairs; Woelher 1993; Guinet et al. 1996; Crossin et al. 2013) and is the closest landfall to Marion Island, lying roughly 900 km east. Between breeding seasons, Macaroni Penguins do not come ashore and have been shown to travel up to 11,000 km (Bost et al. 2009; Thiebot et al. 2011, 2013). During this period, at sea-distribution of Macaroni Penguins breeding at Marion Island and Crozet Archipelago do show some overlap (Thiebot et al. 2013). However, these penguins exhibit a high degree of site and mate fidelity (Williams and Rodwell 1992; Ancel et al. 2013), and thus it is likely that the described individuals originate from Marion Island.

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