

Discolored and worn-out plumage in juvenile Magellanic Penguins (*Spheniscus magellanicus*) found ashore in southeast and northeast Brazil

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ABSTRACT: Magellanic Penguins (*Spheniscus magellanicus*) are common winter visitors of the Brazilian continental shelf. In this study we report the occurrence of discolored and worn-out plumage in juvenile Magellanic Penguins washed ashore during summer on the southeast and northeast coast of Brazil. In the affected individuals, the areas of the plumage that would normally be black or dark grey were discolored to tones ranging from brown to cream-white, especially on the head and dorsum. Upon close examination, the feathers were often brittle and appeared “old” and worn-out, at times leading to irregular and asymmetric patches of feather-loss in the lower back. We propose five factors that could be involved in causing this condition: (a) molt skipping, (b) sun exposure, (c) malnutrition, (d) insufficient preening, and (e) chewing lice.

KEY-WORDS: chromatic aberration, feather-loss, molt, plumage, seabird, *Spheniscus demersus*.

INTRODUCTION

Magellanic Penguins (*Spheniscus magellanicus*) are native to Argentina, Chile and the Falkland/Malvinas Islands and are common visitors of the Uruguayan and Brazilian continental shelves during austral winter (Stokes *et al.* 2014). Magellanic Penguins will normally remain at sea during winter migration (Pütz *et al.* 2007), however a variable number of individuals, predominantly juveniles that are in poor body condition, have previously been reported to wash ashore on the Brazilian coast (García-Borboroglu *et al.* 2010, Rodrigues *et al.* 2010, Stokes *et al.* 2014). As occurs in other penguins, Magellanic Penguins undergo a rapid molt in which all their feathers are replaced over a period of 2–4 weeks (Williams 1995). During the molt, which in the Magellanic Penguin usually occurs between February and April, their plumage loses its waterproofing and as a result the penguins have to remain on land, fasting (Boersma *et al.* 2013b). Molting is therefore an energetically-demanding process that has to be preceded by a period of fattening (with an increase of up to 50–70% in body weight) (Williams 1995), and preparing for molt can be one of the key factors driving

the annual cycle of penguins (Kemper & Roux 2005, Wolfaardt *et al.* 2009).

In March 2010, Petry *et al.* (2017) photographed a juvenile Magellanic Penguin with light brown plumage that had been found ashore on the coast of Rio Grande do Sul state, Brazil. The authors interpreted this aberrant plumage color as corresponding to the first case of a brown mutation in Magellanic Penguins. Brown mutation is a color aberration related to a qualitative reduction of eumelanin (*e.g.*, incomplete synthesis or oxidation), and as a result the black areas of the plumage shift to a light brown tone (van Grouw 2013). In this study we report the presence of juvenile Magellanic Penguins with varying levels of plumage discoloration and feather-loss, some of which closely resemble the brown-plumaged penguin photographed by Petry *et al.* (2017), however we propose a distinct etiology for this phenomenon.

METHODS

The Institute of Research and Rehabilitation of Marine Animals (*Instituto de Pesquisa e Reabilitação de Animais*

Marinhos – IPRAM) is a non-profit organization based in Cariacica (20°19'54"S; 40°21'38"W), Espírito Santo state, that rescues and rehabilitates marine animals found ashore along the coast of southern Bahia (northeast region), Espírito Santo and northern Rio de Janeiro states (southeast region), Brazil. An average of 110 Magellanic Penguins are admitted for rehabilitation per year, a majority of which are juveniles (98%) that are severely debilitated (lethargic/comatose, severely emaciated, dehydrated, anemic and hypoglycemic).

Most penguins (78%) are admitted from July to September, whereas a smaller proportion (22%) is admitted from October to June. In addition to the general state of malnutrition and debilitation that is common to nearly all juvenile penguins found ashore in this region,

the juvenile penguins admitted from October to March every year also frequently present a discolored and worn-out plumage (Fig. 1).

RESULTS AND DISCUSSION

From a sample of 33 penguins admitted from the northern coast of Rio de Janeiro between October and December 2015, 15 penguins (45%) had plumage discoloration and/or patches of feather-loss (see Fig. 1B). In these cases, the areas of the plumage that would normally be black or dark grey are discolored to tones ranging from brown to cream-white. The discoloration is usually more pronounced on the head and dorsum. There are cases, however, where the



Figure 1. Discolored and worn-out plumage in juvenile Magellanic Penguins (*Spheniscus magellanicus*) admitted for rehabilitation along the coast of southeast and northeast Brazil. (A & B) examples of the large numbers of juvenile Magellanic Penguins with worn-out plumage; (C–E) a particularly extreme example of plumage discoloration; (F–H) examples of the different patterns of plumage wear, discoloration and feather-loss and feather replacement on the lower back. Photographs taken in Jan 2013 (C–E), Dec 2013 (A), and Dec 2015 (B, F–H). Photo authors: Renata Hurtado/IPRAM (A, B, F, G, H); Luís F. Mayorga/IPRAM (C, D, E).

discoloration is evenly distributed and all the feathers that would be black have a light brown color instead (Fig. 2A). Upon close examination, the feathers are often brittle and appear “old” and worn-out; in some areas, the barbules may be irregularly broken and the feather shaft is exposed. In many cases, there are irregular and asymmetric patches of feather-loss, especially in the lower back. The loss of feathers may lead the skin to be entirely exposed (*e.g.* Figs. 1E & 1G), but oftentimes a downy plumage grows to form a furry coat in areas where the normal plumage was lost (*e.g.* Figs. 1F & 1H).

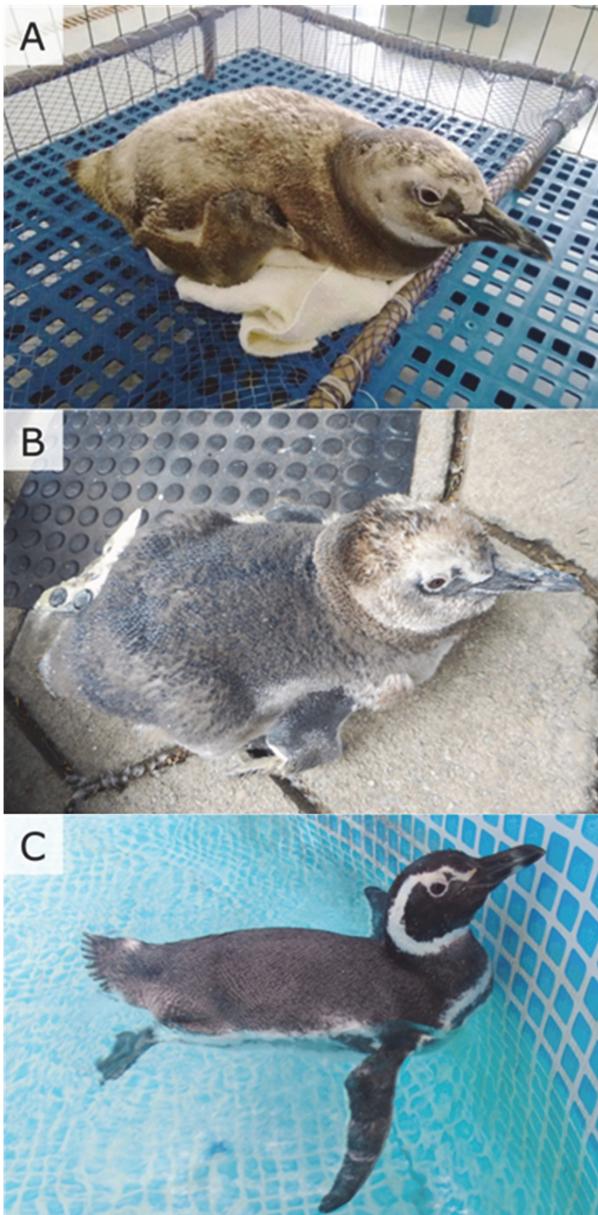


Figure 2. Example of an individual that was admitted with a brown juvenile plumage, underwent molt and emerged with normal adult plumage. (A) bird is lethargic and dehydrated upon admission, with a worn-out pale brown plumage (18 Mar 2017); (B) bird recovers gradually and undergoes molt (24 Mar 2017); (C) bird is fully recovered and completed the molt to a normal adult plumage (19 Apr 2017). Photo author: Luís F. Mayorga/IPRAM.

Despite their generally poor health status (dehydration, malnutrition, lethargy) and the poor condition of their plumage, the penguins with discolored plumage and feather-loss usually respond well to rehabilitation. After a few weeks under care and receiving adequate nutrition (fresh fish and mineral/vitamin supplementation) and deworming medicine, these birds will usually initiate the molt. In a few cases, the penguins with discolored plumage are not debilitated upon admission and instead show signs of pre-molt (good body condition, flipper edema, lethargy). In all cases admitted at IPRAM, when penguins with discolored plumage completed the molt they emerged with an entirely normal black-and-white adult plumage (Fig. 2). If this plumage discoloration had a genetic basis it would be expected that the brown/cream-white color would be maintained even after molt, and we therefore consider that factors other than genetic mutations must be at play.

Because the plumage discoloration we observed in juvenile Magellanic Penguins is invariably accompanied by other signs of poor plumage quality (*e.g.*, worn-out appearance of feathers, patches of feather-loss) and appears to be seasonally distributed, we suggest it is primarily related to feather wear. We propose five factors that could synergize to cause this condition: (a) molt skipping, (b) sun exposure, (c) malnutrition, (d) insufficient preening, and (e) chewing lice.

Juvenile African Penguins (*Spheniscus demersus*) with a light brown and worn-out plumage (Fig. 3) are routinely admitted during summer months at the South African Foundation for the Conservation of Coastal Birds (SANCCOB), in South Africa; these individuals will also invariably emerge with a normal black-and-white adult plumage after molt (R. Hurtado, pers. obs.). In a study on the molting ecology of African Penguins in Namibia, Kemper & Roux (2005) found that some juvenile African Penguins may skip the first molting season and retain



Figure 3. A juvenile African Penguin (*Spheniscus demersus*) with a discolored and worn-out plumage admitted for rehabilitation at the Southern African Foundation for the Conservation of Coastal Birds, South Africa (Dec 2017). Photo author: Renata Hurtado/SANCCOB.

their juvenile plumage until 20–22 months of age. These individuals are referred to as “skippers”, and their plumage is badly worn and not fully waterproof, jeopardizing their ability to forage in cold waters. Juvenile Magellanic Penguins have been occasionally seen in the coastal waters of Rio de Janeiro during summer months (R. Hurtado, pers. obs.), possibly in an attempt to forage in the Cabo Frio upwelling waters. Considering that the nearest breeding colony of Magellanic Penguins is almost 3000 km away from the coast of Rio de Janeiro (Boersma *et al.* 2013b), it is reasonable to suspect that these individuals might not return to their colonies in time to undergo molt in February/March. If this is the case, the plumage of these individuals can be expected to be considerably worn-out by the summer of the subsequent year. We therefore suspect that the cases of plumage discoloration and feather-loss we documented in juvenile Magellanic Penguins in this study represents a situation comparable to the African Penguin skippers, *i.e.* extreme instances of feather wear related to juvenile Magellanic Penguins that skipped their first-year molt.

Considering that the body parts that are usually most intensely discolored are those that stay outside of the water when a penguin swims (see Fig. 1A), prolonged exposure to the sun could also play a role. For instance, the Galapagos Penguin (*Spheniscus mendiculus*) is the northernmost-breeding penguin species and its gray-black plumage is known to gradually progress to a brown tone during the months following molt (Boersma *et al.* 2013a). This species is unique among penguins in that its adults molt twice per year (Boersma *et al.* 2013a), possibly an adaptation to the intense feather wear caused by high solar irradiance near the Equator. Considering that brown plumage discoloration is relatively common in juvenile Magellanic Penguins in northeast and southeast Brazil whereas it appears to be rare in individuals found ashore in southern Brazil (L. Bugoni, pers. comm.), it is possible that plumage discoloration is more frequent in individuals wintering at lower latitudes is related to the Equatorward increase in solar irradiance.

The oily secretion produced by the uropygial gland plays an important role in reducing feather wear, inhibiting chewing lice and feather-degrading bacteria (Shawkey *et al.* 2003, Moreno-Rueda 2010, 2011). Boersma *et al.* (2013a) speculated that the plumage of Galapagos Penguins becomes brown in the period preceding molt because the penguins stop oiling their feathers. Juvenile Magellanic Penguins admitted for rehabilitation in northeast and southeast Brazil have undergone extended periods of malnutrition, as evidenced by the generally poor body condition and health status. It is therefore possible that malnourished juvenile penguins have decreased quantity or quality of uropygial gland secretion, resulting in poorer protection from feather

wear. Additionally, it is known that penguins adjust their foraging schedule in response to prey availability, and in extreme circumstances of shortage of prey some individuals may forage up to 15 h per day, *i.e.* non-stop foraging from dawn to dusk (Culik *et al.* 2000). In these instances, the increased time spent foraging will certainly come at the cost of a decreased time preening, and feather quality is likely to deteriorate as a result. Furthermore, it is also possible that these juvenile individuals had received suboptimal nutrition as chicks, which could have resulted in poor quality feathers that were more susceptible to discoloration and wear.

Chewing lice (*Austrogoniodes* sp.) are common in juvenile Magellanic Penguins on the southeast coast of Brazil, and in some instances they can be found in >95% of carcasses washed ashore (R.E.T. Vanstreels, unpub. data). Chewing lice can cause direct damage to the feathers and accelerate their wear (Kose *et al.* 1999), and can also lead to feather damage indirectly by inducing feather-damaging behavior (van Zeeland & Schoemaker 2014). While it is unlikely that chewing lice cause plumage discoloration, it seems plausible that they might have contributed directly or indirectly to the patches of feather-loss reported in this study.

It is worth noting that Traisnel *et al.* (2018) documented an adult African Penguin whose black plumage had been uniformly replaced by a light brown tone; this case was considered consistent with brown mutation, and the dorsal plumage of that individual was also heavily bleached out. This suggests that in cases of brown mutation, the decreased oxidization of the eumelanin might also make the plumage more susceptible to sun-mediated discoloration. In the case of the juvenile Magellanic Penguins in this study, it is plausible that the eumelanin in the feathers of juveniles may be less oxidized than in the feathers of adults, resulting in an increased susceptibility to discoloration.

In conclusion, juvenile Magellanic Penguins found ashore in southeast and northeast Brazil during summer months frequently present a discolored and worn-out plumage. It seems unlikely that genetic mutations are the cause of these plumage abnormalities. We propose, instead, that the plumage abnormalities we documented are the result of feather wear due to a combination of factors related to the challenges experienced by these birds during their first-year migration.

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