

Feather-loss Disorder in African and Magellanic Penguins

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Abstract.—A feather-loss disorder, first observed in captive African Penguin (*Spheniscus demersus*) chicks in a South African rehabilitation center in 2006, was found one year later in wild Magellanic Penguin (*Spheniscus magellanicus*) chicks in four colonies in Argentina. Two years later, it was found in African Penguin chicks in the wild. The featherless African Penguin chicks in the rehabilitation center (N = 176) lost their down and emerging juvenile feathers, remaining featherless for several weeks until they died (N = 31) or grew juvenile (N = 3) or adult plumage (N = 145) before being released. The featherless African Penguin chicks took 16 days longer to reach the rehabilitation center's standards for release than feathered chicks ($t_{176} = -8.8$, $P < 0.00001$). Likewise, the featherless wild Magellanic Penguin chicks (N = 13) lost their second coat of down, remaining featherless for several weeks; but those that survived to fledging all grew normal juvenile plumage (N = 4). Featherless Magellanic Penguin chicks grew more slowly and were smaller at fledging age than most feathered chicks. The disorder in Africa and Argentina is new, rare, and more common in a rehabilitation center in Africa than in the wild. The cause of the feather loss is unknown, but the disorder results in slower growth, smaller fledglings, and appears to increase mortality in Magellanic Penguin chicks in the wild. Received 21 January 2009, accepted 31 March 2010.

Key words.—African Penguin, feather loss, Magellanic Penguin, *Spheniscus demersus*, *Spheniscus magellanicus*.

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Feather-loss disorders are uncommon in most bird species and rarely reported in wild birds. We report a new feather-loss disorder that exposes bare skin in two species of *Spheniscus* penguin chicks: one in South Africa (but see van Heezik and Seddon (1992)) and the other in Argentina (Fig. 1).

Since 1968, the Southern African Foundation for the Conservation of Coastal Birds (SANCCOB, Cape Town, South Africa) has rehabilitated thousands of African Penguins (*Spheniscus demersus*) and developed a baseline for normal feathering. Likewise, for more than 25 years the Penguin Project (the Project) has studied Magellanic Penguins (*Spheniscus magellanicus*) at Punta Tombo, Argentina (Boersma *et al.* 1990; Boersma 2008), determining the normal feathering pattern.

Normal feathering for *Spheniscus* penguins includes a hatching down, a second layer of down that replaces the hatching down, and juvenile plumage that replaces the second down (Boswall and MacIver

1975). In the following year, the juvenile molts into adult plumage (Williams 1995). A normally-feathered penguin chick has down or feathers covering the body except for the feet and bill.

SANCCOB first observed feather loss in African Penguin chicks in 2006 in the rehabilitation center and in the following year, 2007, the Project found featherless Magellanic Penguin chicks for the first time in Argentina. Here we report the number and severity of feather loss cases in African and Magellanic Penguins.

STUDY AREAS AND METHODS

African Penguin Chicks

SANCCOB began rehabilitating African Penguins in 1968 (Morant *et al.* 1981, Adams 1994; Parsons and Underhill 2005) and treats several hundred African Penguins each year from colonies along the coast of South Africa. These include: Dyer Island (approximately 2,000 breeding pairs; 34°40.6'S, 19°25.0'E), Robben Island (approximately 7,000 breeding pairs; 33°48.3'S, 18°21.6'E) and Betty's Bay (approximately 200 breeding pairs; 34°21.4'S, 18°57.6'E) (Underhill *et al.* 2006).

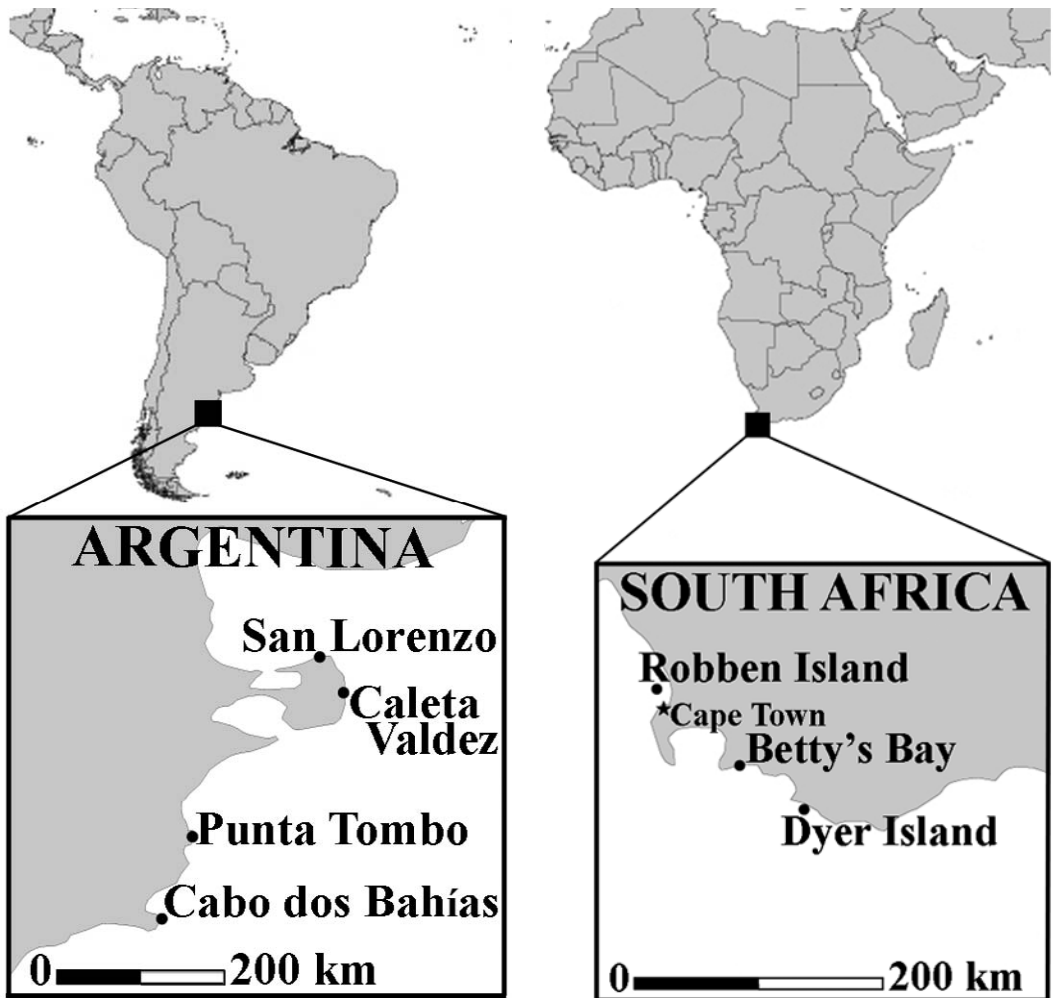


Figure 1. Location of African (*Spheniscus demersus*) and Magellanic Penguin (*Spheniscus magellanicus*) colonies with featherless chicks in Argentina and South Africa.

Upon admission, SANCCOB temporarily bands, deworms, and sprays penguins with Newcastle Disease vaccine (La Sota Strain) and injects supplemental vitamins and iron. SANCCOB archives a record for each penguin, including a weekly plumage evaluation (Parsons and Underhill 2005).

In 2006, 2007 and 2008, SANCCOB admitted 854, 538 and 181 African Penguin chicks, respectively. As in other years, chicks had normal feathering at admission. In 2006 and 2007, SANCCOB removed the majority of these chicks (841 and 481, respectively) from the wild after breeding adults began molting in large numbers and could no longer feed their young. SANCCOB admitted the remaining chicks because they were in poor body condition. Some chicks lost feathers and we tested differences in duration of stay in the rehabilitation center between feathered and featherless chicks using a two-sample *t*-test assuming unequal variances (EXCEL SP3).

Magellanic Penguin Chicks

The Penguin Project handles hundreds of Magellanic Penguins at Punta Tombo, Argentina each year (44°2.7'S, 65°13.4'W) and often visits other colonies, including San Lorenzo (approximately 57,000 breeding pairs; 42°5.0'S, 63°51.8'W), Caleta Valdes (approximately 10,000 breeding pairs; 42°29.3'S, 63°36.4'W), and Cabo Dos Bahías (approximately 9,000 breeding pairs; 45°0.5'S, 65°37.2'W) (Boersma *et al.* 1990; Schiavini *et al.* 2005). Punta Tombo is the largest Magellanic Penguin colony in the world with approximately 200,000 breeding pairs (Boersma 2008).

The Project checks hundreds of nests each year at Punta Tombo to record breeding success, egg laying and chick hatching dates, and to measure known-age chicks every ten days until they die or fledge (Boersma *et al.* 1990; Boersma 2008). We used these data to compare the growth rate of one Magellanic featherless chick

that fledged in 2007 and one Magellanic featherless chick that went missing before 33 days of age in 2008 with the growth of Magellanic second-hatched chicks that went missing before 33 days of age or fledged in 2007 and 2008. Second chicks are generally smaller and grow more slowly than chicks that hatch first (Boersma and Stokes 1995). Additionally, the Project measured the growth of two featherless Magellanic Penguin chicks of unknown age: one at San Lorenzo in 2007 and one at Punta Tombo in 2008. Lastly, in December 2008, when Magellanic Penguin chicks were mainly in their second layer of down, the Project checked more than 17,000 nests and approximately 20,000 Magellanic Penguin chicks at San Lorenzo.

RESULTS

African Penguin Chicks

In 2006, African Penguin chicks developed large featherless patches after being admitted to the rehabilitation center; the disorder was not found in the wild in South Africa until 2008. In 2006, 2007 and 2008, 59 (7% of 854 admitted), 97 (18% of 538) and 20 (11% of 181) chicks lost feathers in the rehabilitation center, respectively (Table 1, Fig. 2). Although those chicks appeared normal at admission to the rehabilitation center, they began losing their feathers and had large bald patches 18 days after admission (SD = 7 days). At about 34 days after admission (SD = 5 days) the chicks began growing new feathers. Chicks that had already begun growing juvenile feathers before feather loss grew adult plumage (N = 145) and chicks that were in their second layer of down before feather loss grew juvenile plumage (N = 3). Only chicks that were fully or partially down-covered lost their down and had bare patches of skin; no chicks in full juvenile plumage lost feathers.

Mortality in the rehabilitation center was similar for featherless and feathered African Penguin chicks in 2006 (8 and 9%, respectively) and 2007 (26 and 28%, respectively). In 2008, mortality of African penguin chicks was lower for featherless chicks than feathered chicks (5% and 12%, respectively). Chicks that lost their feathers took significantly longer (\bar{x} = 59 days; SD = 20) to reach the standards for release (Parsons and Underhill 2005) than feathered chicks (\bar{x} = 43 days; SD = 18; t_{176} = -8.8, $P < 0.00001$).

Additionally, in the wild, in 2008, five African Penguin chicks from Dyer Island, two chicks from Robben Island, and one chick from Dassen Island had large featherless patches (L. Waller, CapeNature, pers. obs.; N. Parsons, pers. obs.). Many additional African Penguin chicks had small featherless patches on their shoulders, a pattern seen in the wild due to pecking or plucking by adult penguins; these chicks were not considered featherless.

Magellanic Penguins Chicks

The Project first documented featherlessness in Magellanic Penguin chicks in 2007 when ten chicks lost their feathers, exposing bare skin. Four of those chicks were at Punta Tombo, three were at San Lorenzo, two were at Caleta Valdes and one was at Cabo Dos Bahías. In 2008, the Project found three featherless chicks: two at Punta Tombo and one at San Lorenzo (Table 1, Fig. 3). The Project found most of these chicks opportunistically; only one of 660 and one of 630 Magellanic Penguin chicks were in Project study nests in 2007 and 2008, respectively. The

Table 1. Year, species, number of African Penguin chicks SANCCOB admitted [total admitted: feathered (N), and featherless (F)], and number of African and Magellanic featherless chicks in the wild.

Year	Species	Total:	# Admitted		# Wild
			N (% Died)	F (%Died)	F (%Died)
2006	<i>S. demersus</i>	854	795 (9)	59 (8)	0
	<i>S. magellanicus</i>	0	—	—	0
2007	<i>S. demersus</i>	538	441 (28)	97 (26)	0
	<i>S. magellanicus</i>	0	—	—	10 (40)
2008	<i>S. demersus</i>	181	161 (12)	20 (5)	6 (—)
	<i>S. magellanicus</i>	0	—	—	3 (33)

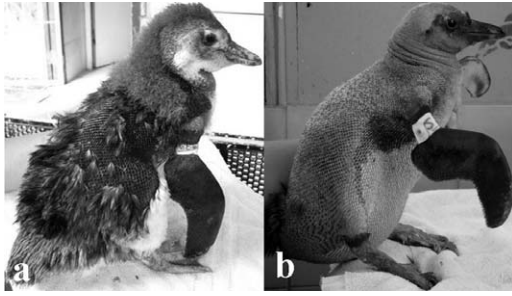


Figure 2. Featherless African Penguin (*Spheniscus demersus*) chicks: (a) African chick losing juvenile feathers and down and (b) adult plumage emerging on an African chick.

2008 featherless San Lorenzo chick was the only featherless chick out of approximately 20,000 chicks checked.

Affected Magellanic Penguin chicks had few or no down feathers on their backs and abdomens, no signs of lesions or inflamma-

tion of the feather follicles and no evidence of feather loss due to plucking or pecking by adult penguins. They were covered with down at hatching, but when they molted their hatching down they lost or failed to grow in their second layer of down. Dorsal skin of three chicks was blue in color and one chick was hot to the touch. Featherless chicks basked in the sun on a hot day when most feathered chicks were in the shade. Five featherless chicks died from unknown causes, four grew juvenile plumage and fledged, and we did not revisit the remaining four chicks. Four of the featherless chicks had siblings, but only one of the siblings had feather loss. One of the featherless study chick's parents had five chicks since 2004, but none had feather loss. The other featherless study chick's parents were newly mated and it was the first time the male had bred.

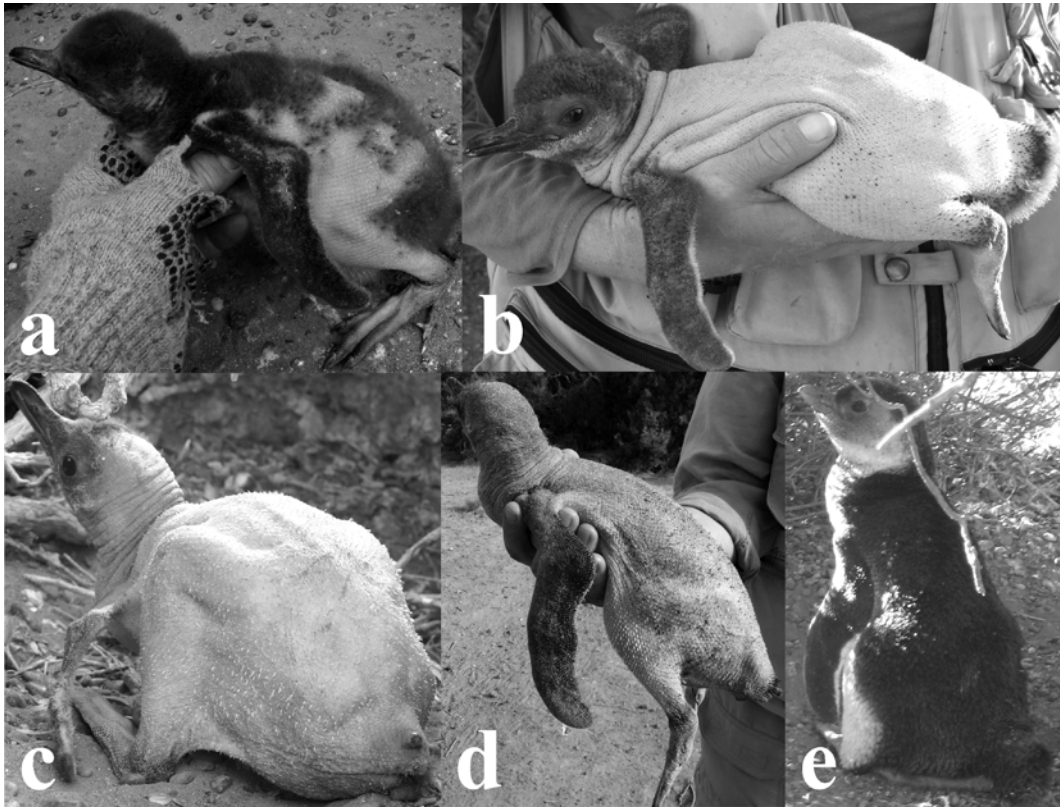


Figure 3. Progression of feather loss in Magellanic Penguin chicks (different chicks shown at each stage): (a) beginning to lose down on abdomen and sides; (b) almost naked, but down remaining on head, flippers and tail; (c) naked with the exception of down near eyes; (d) starting to grow in juvenile plumage; and (e) juvenile plumage fully grown in, healthy but smaller than feathered chicks.

The two Magellanic Penguin featherless study chicks from Punta Tombo (Fig. 4), a featherless non-study chick from Punta Tombo and the featherless chick from San Lorenzo in 2007 were smaller than feathered chicks. The 2008 study chick was feathered from 23 November to 4 December, became featherless by 14 December, and remained featherless until it went missing ten days later when it was 33 days of age. The chick's measurements, prior to losing all its feathers, were similar to feathered chicks. Within ten days of losing all its feathers, its growth slowed and it was smaller than feathered chicks. The chick was in good condition when it disappeared.

The featherless non-study chick's flipper measurements were small compared to feathered Magellanic Penguin chicks (11.3 cm on 17 January 2009 compared to = 15.1 cm, SD = 0.6, N = 27 on 16-18 January 2009); the featherless chick from San Lorenzo had a flipper length of 11.5 cm before fledging,

similar to the featherless chicks from Punta Tombo.

DISCUSSION

Feather loss in penguin chicks first appeared in a South African rehabilitation center in 2006, but did not appear in the wild in South Africa until 2008. In Argentina, the disorder first occurred in four colonies simultaneously the year after its emergence in the South African rehabilitation center. The disorder was more common in the African rehabilitation center than in the wild, suggesting that close contact and/or enclosed spaces facilitated the disorder. The cause of the disorder has yet to be identified and it is unknown whether feather loss in African and Magellanic Penguin chicks is related.

Feather loss in *Spheniscus* penguins has been documented once before, in South Africa in 1989 (van Heezik and Seddon 1992). In that instance, feather loss in African Pen-

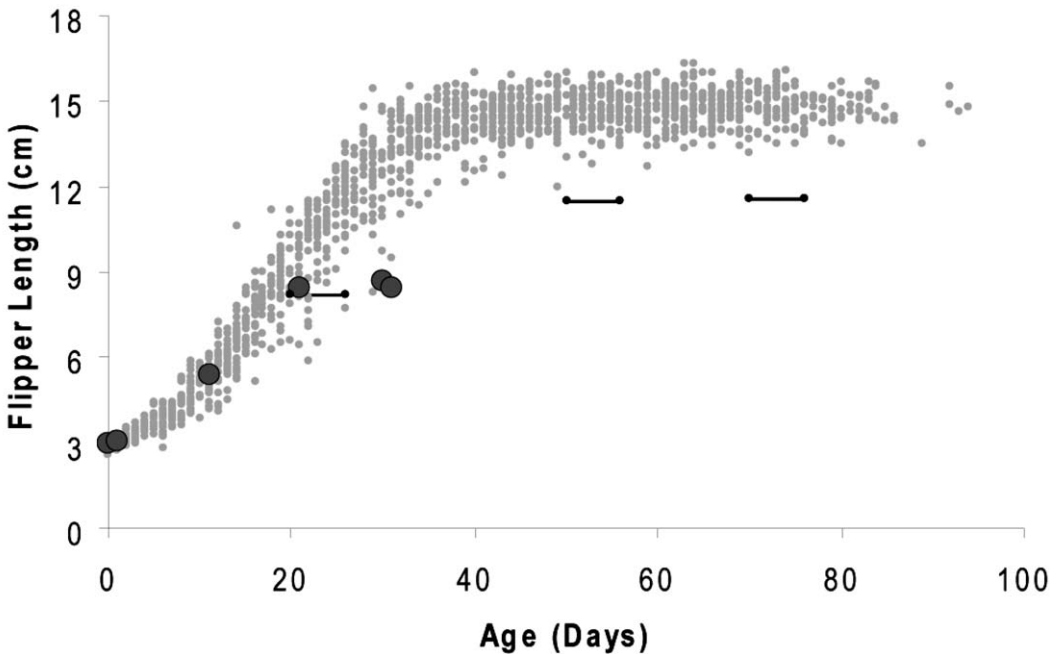


Figure 4. Magellanic Penguin Flipper length (cm) by age (days) of second-hatched feathered Magellanic Penguin chicks that either went missing before 33 days of age or fledged in 2007 or 2008 (N = 221 chicks; label ●), a known-age second-hatched Magellanic featherless chick that went missing at 33 days of age (N = 1; label ●), and a Magellanic featherless chick of age known within a six-day range and of unknown hatch order (N = 1; label ●—; the bar shows the six-day range of possible ages). Second-hatched Magellanic Penguin chicks are smaller than first-hatched Magellanic Penguin chicks (Boersma and Stokes 1995) and therefore a conservative comparison.

guin chicks in the wild was apparently caused by malnutrition, and thus appears to be different from the feather disorder we report. The feather loss since 2006 has affected chicks in a rehabilitation center, where food and supplemental vitamins are provided, as well as wild Magellanic Penguin chicks in good body condition that later grew juvenile plumage and fledged. Malnutrition, therefore, seems an unlikely cause of this feather-loss disorder.

The disorder disrupted feather growth in both species, resulting in chicks with bare skin for several weeks. Feather loss caused most African Penguin chicks to grow adult instead of juvenile plumage. In contrast, Magellanic Penguin chicks grew juvenile plumage, the same as chicks without the disorder. The phase of feather development at which feather loss occurs may explain this disparity. African Penguin chicks lost feathers after beginning to grow in their juvenile plumage, but Magellanic penguins lost their second coat of down before the onset of juvenile feather development. After becoming featherless, the chicks appeared to start the next developmental phase of feather growth.

Featherless chicks are poorly insulated and lose heat, so they should, therefore, have to use more energy to maintain their body temperature than feathered chicks. Increased energy expenditure on thermoregulation should decrease growth. African featherless chicks took 16 days longer to reach release weight than feathered chicks. Likewise, Magellanic featherless chicks grew more slowly and were smaller than featherless chicks. Both the Magellanic featherless chicks grew more slowly and were smaller at the time of their death or when they fledged than Magellanic feathered, second-hatched chicks suggesting the lack of feathers usurps energy usually dedicated to growth.

In the African rehabilitation center, mortality rates were similar for featherless and feathered chicks in 2006 and 2007, but higher for feathered chicks in 2008. In 2008, SANCCOB admitted a higher percentage of young chicks that died before they were old enough to lose their hatching down, which explains the higher mortality rate of feath-

ered chicks in 2008. In the center, chicks had unlimited food and could stay until they were in good condition, which likely contributed to featherless chick survival. Feather loss likely increases mortality in the wild because of the higher energy needs of the chick and their longer fledgling period.

The discovery of featherless chicks in 2006 in Africa and in 2007 in Argentina suggests the disorder is new. Feather loss was more common in the rehabilitation center than in the wild, indicating the disorder is more likely to occur in close contact and enclosed spaces. The disorder appears to reduce chick growth in both species and is likely to increase chick and fledgling mortality in African and Magellanic Penguins in the wild. Feather-loss disorders are uncommon in most bird species, but they can be caused by pathogens, thyroid disorders, nutrient imbalances, pollution or genetics (Bernier *et al.* 1981; Arends 1997; Johne and Müller 1998; Hoffman 2002; Leeson and Walsh 2004; Bert *et al.* 2005; Gartrell *et al.* 2005; Lennox 2007). Further study is needed to determine the cause of the disorder and whether it is spreading to other penguin species.

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