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## COLOUR ABERRATIONS AND PHYSICAL DEFORMITIES IN THE KING PENGUIN *APTENODYTES PATAGONICUS* AT THE CROZET ISLANDS

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### SUMMARY

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Nineteen cases of colour aberrations and physical deformities were recorded in King Penguins *Aptenodytes patagonicus* at Île de la Possession, Crozet Islands, southern Indian Ocean in 1966–1970 and 1995–1996. Colour aberrations consisted of total and partial melanism, isabellism and albinism, and of a bird with a yellow patch on its crown. Physical deformities consisted of a three-legged chick and chicks with a crossed beak and a pronounced scoliosis. The most likely explanation for the observed abnormalities seems to be nutritional disorders as well as genetic errors during DNA-replication.

Keywords: King Penguin, *Aptenodytes patagonicus*, colour aberrations, deformities

### INTRODUCTION

Plumage colour aberrations are reputed to be extremely rare in King Penguins *Aptenodytes patagonicus*. Van Wyk (1995) and Blight & Stevens (2000) record only a few cases, three of them concerning melanistic birds and three others isabellistic (pale brown) and albinistic ones. Until now, physical abnormalities have not been recorded, except for a chick with a crossed beak observed several times on Marion Island in 1997, apparently in good condition (D.C. Nel pers. comm.). During sojourns at Île de la Possession, Crozet Islands (46°25'S, 51°45'E), from 3 January–26 December 1966 (J-F. V.), 12 January 1968–2 January 1969 (J-L. M.), 2 January 1969–4 January 1970 (M.S.) and 8 December 1994–19 March 1996 (Y. R-C.), we paid frequent visits to the large King Penguin colony of la Grande Manchotière, which lies near the station. Each of us also made a dozen excursions to the smaller colony of la Petite Manchotière, at the Baie Américaine, and the last three authors also visited the large colony of le Jardin Japonais, in the north of the island. At each visit, we noted colour and physical abnormalities observed. Because the field work of the three first authors was focused on species other than penguins, their observations were not systematic. Y. R-C., however, worked on penguin biology in the Grande Manchotière almost every day. As a whole, our observations can be considered as giving an idea of the annual frequency and range of such

abnormalities in these two colonies. We also looked for King Penguin specimens with plumage abnormalities and physical deformities in the collections of the Muséum national d'Histoire naturelle, Paris (M.N.H.N.).

In 1966 the numbers of King Penguins breeding at the Grande and Petite Manchotière were estimated to be 56 000 and 3650 pairs at the peak of the season, respectively, but owing to the large spread in the time of egg-laying in this species, their total numbers must have been much higher and possibly reached 80 000 (Voisin 1971). More recently, the numbers of breeding pairs at la Grande Manchotière was estimated to be around 45 000 (Weimerskirch *et al.* 1992).

### RESULTS

#### Colour aberrations

Partial or total melanism makes up about half of the colour aberrations we observed, not counting chick No. 6 (Table 1). The totally melanistic bird (No. 1) was a juvenile with some down remaining on its head. This down was of the usual brown colour. It had no auricular patches, but the feathering of these places differed from that of the rest of the body in being slightly brownish. Its

beak was entirely black. It seemed in good condition, and was well integrated in a group of normal juveniles which did not seem to react particularly to its dark colouring.

The four near-totally melanistic birds (Nos 2, 3, 4 and 5, Table 1) were all very similar: the plumage of their underparts was like that of their upperparts, that is, black with a somewhat scaly, greyish blue hue caused by the bluish distal part of the barbs, the centre of the feathers being black. At places where bluish barbs were worn away, like the upper chest, this plumage looked darker than that of the back. The orange-yellow patches on the head were the same as in other birds, but the top of their upper breast was not bordered by any orange colour, contrary to normal breeding birds. In life, the beak of bird No. 3 was black, and its mandibular plates were vivid orange with a purple border. Its irises were coloured normally. It was in good condition and weighed 11.5 kg. Bird No. 4 had brown irises, orange plates and weighed 10.8 kg. Bird No. 5 did not seem to be breeding and stayed in a group of idle birds. It was apparently in good condition, but was slightly thinner than the other idle birds around it. Its mandibular plates were orange. Other King Penguins did not appear to pay any particular attention to it. It was seen again several times during a few days after 7 December 1995. These four birds looked similar to that illustrated by Blight & Stevens (2000). The down of the large probable melanistic chick (No. 6) was almost black and decidedly darker than that of the neighbouring chicks. This bird seemed also to be in good condition, but was never seen again, something

which is not surprising because of the high number of chicks present in the colony at that time.

Bird No. 7 was a juvenile having recently lost its down. Its head and neck were completely black, without any trace of yellow colour; the remainder of its plumage was normal. Bird No. 8 is, to our knowledge, the only case of largely asymmetrical partial melanism recorded in King Penguins. It had a large black patch extending from its neck to the level of its lower sternum, covering all its right side and a small part of its left side. It was not oiled. This bird was not seen again.

Like other penguins, King Penguins may sometimes have a very few dark feathers spread among the white ones of their underparts. Four out of 20 (20%) normally coloured King Penguin specimens from the Crozet and Kerguelen Islands in the collections of the M.N.H.N. have each one black feather on the side of the abdomen. As these feathers were inconspicuous lying among surrounding white ones, they are unlikely a cause of bias in collecting, and we conclude that their occurrence is high among King Penguins at these two localities.

Isabellism is customarily used to define birds with an aberrant, pale brown or beige colouration where conspecifics are dark. This qualification is not correct, since isabelle is in fact a fairly dark colour (No 4D7 in Wanscher & Kornerup 1991), but it has become established in the literature. Adult No. 9 was entirely beige on its

TABLE 1

Colour aberrations in King Penguins *Aptenodytes patagonicus* at île de la Possession, Crozet Islands

No.	Colour aberration	Stage	Date	Locality	Remarks, collector/observer
1	Total melanism	Juvenile	9 Feb. 1995	Grande Mançhotière	Entirely black, no yellow on neck and head. Observed (Y. R-C.).
2	Near total melanism	Breeder	3 April 1964	Grande Mançhotière	Underparts as dark as upperparts. Collected (Dr. Gaudin), No. C.G. 1965-1130.
3	Near total melanism	Adult	3 March 1966	Grande Mançhotière	Underparts as dark as upperparts. Collected (J-F. V.), No. C.G. 1967-874.
4	Near total melanism	Adult	16 Dec. 1968	Grande Mançhotière	Underparts as dark as upperparts. Collected (J-L. M.), No. C.G. 1969-911.
5	Near total melanism	Adult, possibly not breeding	7 Dec. 1995	Grande Mançhotière	Underparts as dark as upperparts. Observed (Y. R-C.).
6	Total melanism?	Large chick	17 May 1966	Grande Mançhotière	Very dark brown. Observed (J-F.V.).
7	Symmetrical, partial melanism	juvenile	5 Nov. 1970	Grande Mançhotière	No yellow on neck and head. Observed (M.S.).
8	Asymmetrical, partial melanism	Adult, breeder?	24 Jan. 1966	Petite Mançhotière	Large black patch on chest. Observed (J-F. V.).
9	Total isabellism	Adult, breeder?	25 Nov. 1966	Grande Mançhotière	Collected (J-F. V.), No. C.G. 1967-877.
10	Total isabellism	Adult	17 Dec. 1968	Grande Mançhotière	Observed (J-L. M.).
11	Total isabellism, partial albinism	Large chick	23 April–26 July 1968	Grande Mançhotière	Observed (J-L. M.) several times.
12	Partial isabellism	Large chick	7 July 1966	Petite Mançhotière	Observed (J-F. V.).
13	Partial isabellism	Large chick	5 Sep. 1968	Baie Américaine	Observed (J-L. M.).
14	Partial albinism	Adult	17 Dec. 1968	Grande Mançhotière	Observed (J-L. M.).
15	Large, vivid greenish yellow patch on crown	Adult	30 Dec. 1968	Grande Mançhotière	Observed (J-L. M.).

TABLE 2

**Physical deformities in King Penguins *Aptenodytes patagonicus* at île de la Possession, Crozet Islands**

No.	Malformation	Stage	Date	Place	Observer
16	Supplementary foot	Large chick	28 April 1966	Grande Manchotière	J-F.V.
17	Crossed beak	Large chick	25 June 1966	Grande Manchotière	J-F.V.
18	Very marked scoliosis	Large chick	23 April 1968	Grande Manchotière	J-L. M.
19	Cyst above right eye	Small chick	13 November 1970	Grande Manchotière	M.S.

upperparts, except for its head and neck, as well as a narrow border between its upperparts and white underparts, which were pale brown. The orange-yellow patches on its neck were normal. Its beak was brown, paler toward the tip, and its legs were pale red. It resembled the bird illustrated by Van Wyk (1995). Bird No. 10 was much the same as No. 9, but details about its colouration have not been recorded. The down of chick No. 11 was entirely pale beige, its beak was black and white. The upper parts of the legs were beige, whereas the lower parts were white. Its irises were very light brown. In this case, partial albinism might have been coupled with isabellism. This chick was seen several times.

The partially isabelline chick No. 12 was normally coloured, except for a large isabelline diamond-shaped patch with clear-cut borders extending symmetrically on its chest and belly. It was not seen again. Chick No. 13 exhibited a rather different pattern, with beige tufts disseminated among the normally coloured brown down of its head and belly. Adult No. 14 had a normal plumage, except for a large white patch in the middle of its back. Bird No. 15 had a patch on its crown, the vivid greenish-yellow colour of which differed from the normal orange yellow of its neck patches.

No colour aberrations in King Penguins were recorded at île aux Cochons, Crozet, from 9 January to 19 April 1974 (J-L. M. & J-F. V.) and from 12 to 21 February, 1982 (J-F. V.). This island holds the world's largest King Penguin concentration, of about one million birds, most of them breeding in a huge colony of about 200 000 pairs (Derenne *et al.* 1976). Additionally, neither of the first three authors noted colour aberrations among King Penguins at île de l'Est, Crozet, where they stayed from 24 December 1970 to 23 February 1971 (J-L. M. & M. S.) (Despin *et al.* 1972) and from 22 February to 3 March 1982 (J-F.V.).

### Physical deformities

The three-legged chick No. 16 was found dead. Its third foot was small and appended to its right thigh. It had only two digits. This specimen was not preserved because of its state of decomposition. Chick No. 17 had its maxilla and mandible horizontally crossed, not fitting one into the other when the beak was closed, but diverging a little. It seemed to cope with its infirmity and to be well fed by its parents, but was not seen again. Chick No. 18 seemed to be in good condition despite its pronounced scoliosis. Finally, bird No. 19 was a small chick not yet having acquired its down (Table 2).

### DISCUSSION

In the case of the obvious, easy-to-detect, abnormalities which we observed in King Penguins at the Crozet Islands, two main hypotheses may be put forward:

1. Non-genetic developmental disturbances caused by nutritional disorders resulting in osteogenesis (lateral curvature of the spine, or scoliosis) or chromatic (melanism) anomalies because of, for instance, hypo- or hyper-vitaminoses;
2. Genetic 'errors' (mistakes occurring during DNA-replications) resulting in recessive, more or less detrimental mutations. These recessive alleles are slowly replaced by new mutations in proportion as they are eliminated by natural selection.
3. The presence of rare phenotypes existing in equilibrium in the population, especially in the case of colour aberrations. This hypothesis does not exclude completely the preceding one.

Taking into account that anomalies of traumatic origin during growth are always possible, the first hypothesis may play a role, even if King Penguins live in an environment where they can fulfil all their qualitative and quantitative food requirements. King Penguin chicks undergo a starvation period over winter (Weimerskirch *et al.* 1992), and those that are hatched late in the season will enter this period while they are still small, which may result in their death. In their case food shortage can certainly affect development, causing beak and spine deformations among other things. This could also be the case of the beak deformations observed at a somewhat higher rate by Pütz & Plötz (1991), Spletstoesser (1997) and Spletstoesser & Todds (1998) in chicks of the closely related Emperor Penguin *A. forsteri*, which breeds in much harsher conditions around the Antarctic Continent.

However, the scarcity of the observed, obvious anomalies (19 in a little over four years) in relation to the very high numbers of King Penguins living along the eastern coast of île de la Possession favours the second and third hypotheses, and mainly so in the case of colour aberrations. A better understanding of these phenomena necessitates more, quantified observations, as well as genetic studies.

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