

Short Communications

Timing of King Penguin Breeding at Marion Island

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King Penguins *Aptenodytes patagonicus* breed in a circumpolar distribution, with 31% of the world population occurring at Marion Island in the Prince Edward Island group (46°53'S, 37°54'E) (Adams & Klages 1987). The breeding cycle of the King Penguin is unique among penguins in taking more than one year to complete (Stonehouse 1960; Barrat 1976; Weimerskirch *et al.* 1992). Because the timing of breeding of individual penguins is influenced by the outcome of their previous breeding attempt (Stonehouse 1960; Barrat 1976; Weimerskirch *et al.* 1992), there is a considerable spread in the dates over which egg laying occurs. Chicks are subject to a winter period when they receive little or no food, and since late-hatched smaller chicks are less likely to survive this period (Stonehouse 1960; Barrat 1976; Cherel *et al.* 1987), timing of breeding events will affect chick survival and ultimately population growth. Of the three localities that have been examined previously, Heard Island (53°05'S, 73°30'E) and Possession Island (46°30'S, 52°30'E) in the southern Indian Ocean have egg laying periods extending over three months, from late-November to mid-February (Barrat 1976; Weimerskirch *et al.* 1992; van den Hoff *et al.* 1993). However, at most southerly situated South Georgia (54°S, 37°W), in the south Atlantic, egg laying was observed over four and a half months (Stonehouse 1960). In this paper we document the timing of reproductive events at Marion Island, a previously unstudied locality.

Methods

Study area

Data were collected from King Penguins breeding at Archway Bay, Marion Island, between September 1989 and January 1991. Archway Bay is on the north-east coast and supports a King Penguin breeding colony of more than 2,000 breeding pairs (FitzPatrick Institute unpubl. data). It comprises a small boulder beach

backed by a flat shingle and boulder area where breeding occurs, and is surrounded by steep rock cliffs.

Bird marking and observations

As part of a study of the breeding cycle of the King Penguin, birds were banded with individually numbered, stainless steel flipper bands. For the current study 140 pairs of birds were also marked with white, fibre-reinforced plastic tags wrapped around the flipper band or held in place with a plastic cable tie, bearing individual numbers written with a permanent marker (Eggleton 1976). Pairs were marked during the copulation and post-copulation phase. Sex of the paired birds was determined by morphometrics (Stonehouse 1960) or position during copulation.

The colony was surveyed approximately once a week during the pre-egg stages and the numbers of moulting, courting and copulating adults counted. Courting and copulating activities were recorded over periods of up to eight hours of continuous observation, three times a week, during the entire courting/copulating period. Courting was scored if the pair displayed advanced courtship behaviour such as mutual head-flagging and displaying of the auricular patch, after mutual calling (Stonehouse 1960). Observational data collected between 0700-1900 h were pooled and divided by the total number of observation hours to give a rate of occurrence. From egg laying to the end of brooding the colony was monitored daily from the periphery. Dates of laying and hatching were determined for a sample of marked birds that could be observed from the periphery of the colony.

Results

Adult moult

In the first season (1989-90) numbers of adults in the colony increased rapidly between September and late October, dropped in late November and then peaked in

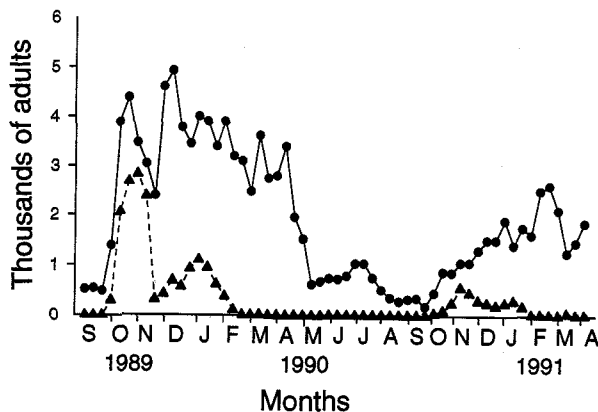


Figure 1 Numbers of adult (●) and moulting (▲) King Penguins at Archway Bay, 1988–89.

December. Thereafter numbers declined steadily. A peak in the number of moulters (2820) was reached in late October 1989 (Fig. 1). A second wave of moulters was evident from December 1989, with peak numbers (1100) in the first week of January 1990. Very few moulting adults were seen in March 1990 and the last individual was observed in the second week of April.

The pattern of increase was similar in the second season, although the timing and absolute numbers of both adults and moulters differed. Adult numbers peaked in early January (1990) and late February (2600) of 1991, and moulters peaked in early November (560) with a subsequent smaller peak in mid-January (300). First moulting birds (2) were observed on 20 September and only few (11) remained at the beginning of April.

Courtship and copulation

Courting activities were already underway in the first week of November, when observations began. Numbers of courting birds peaked on 11 November and then reached a second smaller peak in the second week of December (Fig. 2). No courting was seen after 18 January 1990. Copulation was first observed approximately one month after the start of courtship, on 7 November 1989, and peaked in the second week of December 1989. A smaller peak was observed in mid-January and copulatory activity continued sporadically throughout February 1990.

Egg laying

The first eggs laid were observed on 25 November 1989. Egg laying peaked in the third week of December 1989 (Fig. 3), although there was a lesser peak in late

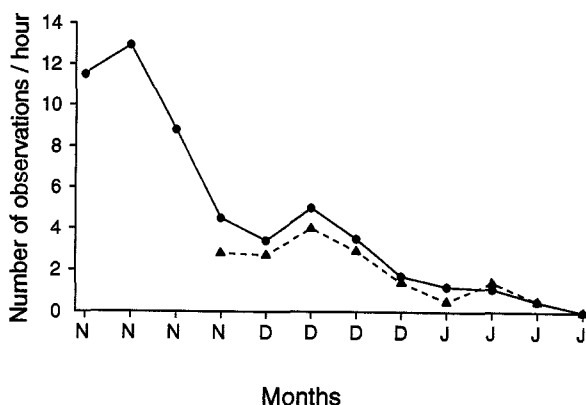


Figure 2 Number of observations of courting (●) and copulating (▲) pairs of King Penguins per hour, at Archway Bay, from November 1989 to January 1990.

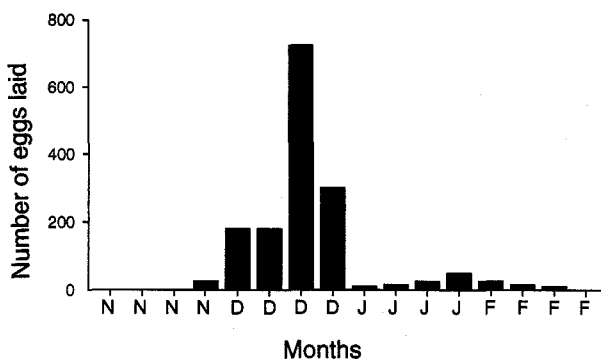


Figure 3 Span of egg laying of King Penguins at Archway Bay, 1988–89.

January. The last eggs laid were observed on 21 February 1990.

Chick phase

The first chicks were observed hatching on 21 January 1989 and the last on 19 April 1989. Chicks were closely brooded for the first 20 days, gradually becoming more independent until the end of the guard stage at approximately 80 days after hatching. Unattended chicks began to form loose creches during early April. Chicks moulted their down between November 1989 and January 1990, with a mean fledging period of 11.6 months, calculated from the difference between mean hatching and mean departure dates. The overall breeding period, from laying in 1988 to chick fledging in 1989–90, averaged 13.4 ± 0.5 months (range 13–14, $n = 8$).

Discussion

Timing of moulting, courting and egg laying on Marion Island was essentially the same as at Possession Island in the Crozet group (Barrat 1976; Weimerskirch *et al.* 1992), and at Heard Island (van den Hoff *et al.* 1993). The study on Possession Island spanned three seasons and it showed some inter-annual variation in the dates of onset of moult (a total range of 16 September to 1 October for three years) and egg laying (total range of 21 November to 6 March; Weimerskirch *et al.* 1992). Dates from Marion Island fall within these ranges. At Heard Island egg laying also fell between mid-November and ended by mid-February. However, three periods of egg laying were identified, each separated by a few days when no eggs were laid (van den Hoff *et al.* 1993). Marion Island penguins showed only two peaks of egg laying: a large peak in mid-to-late December and a much smaller one in late January. Chicks moulting at Marion Island did so within the same time-span as those at Possession Island, whereas those on Heard Island appeared to moult a little earlier in the season. In this respect Marion Island birds behaved more like their closest neighbours on Possession Island.

The sequence of moulting, courting and egg laying by King Penguins at South Georgia also showed two waves, but the egg laying period extended for an additional month into April, with the second wave occurring in mid-February rather than late January (Stonehouse 1960). In contrast, egg laying at the other three localities had finished by the end of February, or very early in March. Chick moult at South Georgia also finished about a month later than at the other localities; moulting chicks were observed in the colony as late as early February (Stonehouse 1956). The sudden drop in numbers of adults observed in the Marion Island colony in late November 1989 and January 1991, occurring after peak moulting, probably represented the departure of adults beginning the post-moult period of fattening up.

The pattern of an initial larger peak of egg laying early in the season, followed by a smaller peak late in the season is consistent with what is known about the breeding strategy of this species. According to Stonehouse (1960) the initial large peak is made up of early breeders, i.e. those that either failed to rear a chick in the previous season or took a year off. Successful breeders on Marion Island fledged their chicks between late November and January, and following this, underwent their pre-nuptial moult. Therefore, their subse-

quent breeding attempt should be delayed, and this accounts for the second wave of moulting, courting and egg laying. Although there is evidence to suggest that moulting and then the fattening up post-moult periods of late breeders can be sped up in some years (Weimerskirch *et al.* 1992), these birds will still lay significantly later than early breeders. It is interesting that Stonehouse (1956) noted that late breeders at South Georgia outnumbered early breeders by a ratio of about 3:2. This was not found at Marion Island, where 84% of all breeding attempts were early (van Heezik *et al.* 1994), nor at Possession or Heard Islands (Weimerskirch *et al.* 1992; van den Hoff *et al.* 1993).

The Archway Bay colony showed inter-annual variation in numbers of adults and moulters present, and in the timing of peaks in numbers. In the second season (1990-91), peaks in adult numbers and the initial peak of moulters were smaller and occurred about three to four weeks later than in the first season. The second peak of moulters in 1991 was smaller but occurred at about the same time as in 1990. Similar inter-annual variations in numbers and timing have been recorded at other colonies on Marion Island (FitzPatrick Institute, unpubl. data), although the reasons for such changes are not yet clear. Weimerskirch *et al.* (1992) reported a marked reduction in numbers of breeding pairs at several colonies on Possession Island, as well as inter-annual variations in the timing of laying and commencement of winter fasting by chicks. They suggested these variations resulted from changes in food availability and also from breeding success in the previous year. A low breeding success in one season means a higher number of birds breeding early in the following season, with an enhanced breeding success, since early-hatched chicks are more likely to survive until fledging.

In general, timing of moulting and egg laying at three out of the four localities examined was consistent, with King Penguins at the most southerly site, South Georgia, behaving differently. Parameters that may influence timing of breeding events, such as food supply, climatic features and foraging behaviour, have not been studied in detail at each locality, though some differences in diet have been shown. Stomach contents of King Penguins at South Georgia consisted mainly of squid (Croxall & Prince 1980, 1982; Adams & Klages 1987), whereas on Marion Island most of the wet mass in the diet was fish (Adams & Klages 1987). At Possession Island, Barrat (1976) identified squid as being the primary prey but Cherel & Ridoux (1992) have more recently shown that stomach contents of adults feeding

chicks contained mainly fish. Differences between localities are evident but there is not yet sufficient data from all localities to draw conclusions as to why discrepancies in timing exist.

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