



Falkland Islands Penguin Census 2000/01



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SUMMARY

During the austral summer of 2000/01 a census of all breeding King Penguins (*Aptenodytes patagonicus*), Gentoo Penguins (*Pygoscelis papua*) and Rockhopper Penguins (*Eudyptes c.chrysocome*) was carried out. The number of immature King Penguins has decreased by 19% from 339 to 275, which is probably a reflection of variable breeding success rather than a decline in breeding pairs. The number of Gentoo Penguins has increased by 75% from 64,426 breeding pairs in 1995/96 to 112,771 breeding pairs in 2000/01. This large increase was found to be possible following calculations based on average breeding success and adult and chick survival rates during the intermediate period. The Rockhopper population appears to be stable or increasing with 271,514 breeding pairs of Rockhopper Penguins in 2000/01 compared to 263,590 breeding pairs in 1995/96 (the difference being within the 5-10% error margin).

INTRODUCTION

Only two complete censuses have been carried out in the Falkland Islands since records began with the most recent census (1995/6). Since the 1995/6 census the number of immature King Penguins has fluctuated but in recent years, declined slightly. Most Gentoo Penguin study populations have experienced an increase in breeding pair numbers, whilst those of Rockhopper Penguins have generally remained stable. A third census was planned to monitor further the numbers of King, Gentoo and Rockhopper Penguins breeding in the Falkland Islands.

METHODS

Three different methods were used to estimate the total number of breeding pairs at each site:

1. For all Gentoo Penguin colonies and some of the smaller Rockhopper colonies, direct counts of birds on nests were made. Counts were made either by walking slowly around the colony, or by 2 people with binoculars from a vantage point, at least 3 separate times using tally counters. The estimated error of this method is very low and should not exceed $\pm 5\%$;
2. For inaccessible sites (e.g. South Jason Island) or at sites where colonies are scattered on steep cliffs (New Island, West Point Island and Grave Cove) colonies were photographed from a boat. Counts were then made from the photographs taken (320 in all). This method was judged to be as accurate as direct counts, with an error of $\pm 5\%$ (N.Huin pers.comm);
3. A third method was devised for colonies too big to count directly (Beauchêne, Steeple Jason and Grand Jason islands). Firstly, the area occupied by the colonies was measured. This was achieved by measuring the perimeter of the colony with a rope, which is marked at 2 metre intervals and a compass. At each point of direction change, a distance and an angle from the previous point is noted. Each point was then given a pair of orthogonal co-ordinates from the original measured polar values (x axis value being the distance from previous point times the sine of the angle; y axis value being the distance from the previous point times the cosine of the angle). This set of relative co-ordinates is transformed into absolute values and translated so that all values are positive. The total colony area is then calculated from this set of values. Secondly, estimates of the densities of nesting birds within the colonies were measured. This is achieved by following transect lines within the colonies. The number of transects is dependent on the size and homogeneity of the colony. Two people cross the colony in one line and mark the ground every five metres using a pre-marked rope and return along the same line at a perpendicular angle and five metres apart. Counts of nests (occupied and empty) were then made back along the line every five marked metres, thus counting along the transect-line by every 25 metres square. When counts differed from one observer to the next, the square was recounted. All counts were then averaged to produce an overall estimate for the density of birds in each colony. The total number of breeding pairs within each

colony was calculated from the area of the colony and the density. (N.Huin, pers.comm)

Estimating the error inherent to this method is difficult. Error can arise in the measurement of the colony perimeter and can be assessed as follows. For each colony measured, the last point should be at the same position as the starting point. Any difference between these two sets of co-ordinates represents the cumulative error (either positive or negative) of all points measured. Of the colony perimeters measured the final and start points were separated from between 0.8 and 75 metres, giving an average error of 2.9%. This is further compounded if the colony is not entirely flat but comprises rises and folds of the ground (in which case the actual size of the colony is greater than the area calculated from its perimeter). There is also error associated with the estimate of the colony density, especially if there is large variation in density from one part of the colony to the next. This error was assessed on Beauchêne Is and found to be around $\pm 10\%$ (N.Huin pers.comm). For a full worked example of how the transect method works see Huin (Falklands Conservation Report 1).

RESULTS & DISCUSSION

King Penguins

All of the King Penguin chick counts were made during November 2000. The total number found was 275 (Table 1), the largest colony was 258 chicks which were observed at Volunteer Green. From other colonies we know that, on average, they breed once every year. However, one of these attempts usually fails, resulting in one successful breeding attempt every two years. The count that we conducted during November constitutes all of the successful breeders. The total number of breeding pairs includes the successful and the failed breeders. Failed breeders either started their breeding attempt too late or the chick died. Generally we can multiply the number of immatures by two to get the total number of breeding pairs (but this will be an under-estimate). However, it is still more complicated than this, because some birds are able to raise 2 chicks in 3 years. Consequently, a number of 258 immatures would indicate a minimum number of 344 pairs (based on 2 chicks in 3 years) and 516 pairs (based on 1 chick in 2 years), not taking into account adult and chick mortality (K. Pütz, pers.comm.). Observations during February 2001 indicated that there were around 500 breeding pairs (K.Pütz pers.comm.), which falls within the estimated minimum values. Figures 1 and 2 illustrate the distribution and relative sizes of populations of King Penguins. Curiously, the sites where King Penguins breed in the Falkland Islands are in an almost direct line with South Georgia where one of the largest King Penguin colonies is located, indicating that the penguins may well have colonised the Falklands from South Georgia.

Table 1. Numbers of King penguin chicks at locations around the Falkland Islands in 2000/01 and 1995/96.

ID	SiteID	Farm	Site	Date 2000/01	Nests 2000/01	% of Total	Date 1995/96	Nests 1995/96	% of Total	Increase/ Decline
1	E	Bluff Cove	The Lagoon	10/11/00	1	0.4%				
2	E	Johnson's Harbour	Cow Bay	28/11/00	1	0.4%				
3	E	Johnson's Harbour	Lagoon Sands	27/11/00	12	4.4%				
4	E	Johnson's Harbour	Volunteer Green		258	93.8%	11/11/95	330	97.3%	-18%
5	E	Murrell Farm	Kidney Cove	18/11/00	1	0.4%	28/10/95	2	0.6%	-50%
6	E	Salvador	Concordia				26/11/95	1	0.3%	
7	E	Smylies Farm	Paloma Beach				12/11/95	1	0.3%	
8	I	New Island					01/12/95	1	0.3%	
9	I	Saunders Island	The Neck	14/11/00	2	0.7%	01/12/95	3	0.9%	-33%
10	I	Sea Lion Island	Sea Lion Island	21/11/00	0	0.0%	12/11/95	1	0.3%	-100%
Total					275			339		-19%

Gentoo Penguins

The onset of the 2000/01 breeding season was about 2 weeks later than usual. As a result most Gentoo colonies were just starting to lay eggs at the end of October and early November. Thus 9% of the breeding pairs were counted during October, 77% during November and 14% in December.

The state of the Gentoo population in 2000/01 was $113,000 \pm 5\%$ (Table 2). A total of 101 breeding sites (106 when separated by sub-colonies) which ranged in size from 1 to 5,528 breeding pairs. Forty-one of the sites had colonies $>1,000$ breeding pairs which accounted for 70% of the total population. Figures 3 and 4 illustrate the distribution and relative size of colonies. Thirty-seven percent of the colonies were found on East Falkland, however these colonies accounted for only 19% (21,000 breeding pairs) of the total population, thus there are many relatively small colonies. Conversely on West Falkland and the outer islands, 33% and 29% of the colonies contained 42% (48,000 breeding pairs) and 39% (44,000 breeding pairs) of the breeding pairs, respectively. Figure 4 illustrates that Gentoo colonies are distributed fairly evenly around the Islands, with the majority of breeding pairs distributed around the West and outer islands.

From Table 2 we can see that the Gentoo population is currently increasing, with a 75% increase since the 1995/96 census from 65,000 to 113,000 pairs today. Whilst this appears to be a rather dramatic increase, following a calculation using the 1995/96 population figure, the average breeding success (over the past 5 years = 0.97 chicks per breeding pair), and average adult (0.8) and chick (0.4) survival rates (from Williams, 1995), we estimated the population for 2000/01 to be around 100,000 pairs (assuming a closed system - no immigration or emigration). Bearing in mind that the figures for breeding success and survival of chicks and adults are averages from both the Falklands (breeding success) and other sub-Antarctic islands (survival rates), the population may well have been under-estimated. There is currently no data available regarding possible immigration/emigration of Gentoo Penguins, although the general feeling is that most birds do not migrate very far in the winter months and in fact up to 50% of the birds remain in the colony. Thus it is highly realistic to assume that the population has expanded purely from successful breeding and survival rates. Bennett (1933) estimated

the breeding population at 116,020 pairs in 1932/33, which is just 3% more than in this census.

Note: To our knowledge only two colonies were not counted during this census, these were the New Island South Wildlife Reserve colony and the Fourth Passage Island colony.

Rockhopper Penguins

Rockhopper Penguins, like Gentoo Penguins, started breeding later than usual during the 2000/01 season. Despite this, the key southern colony, Beauchêne Island, was counted at the end of October, as most eggs had been laid. Thus 24% of the total population was counted in October at Beauchêne Island and the remainder, 74% and 3% counted in November and December, respectively. The state of the Rockhopper population during 2000/01 was $272,000 \pm 5\%$ breeding pairs (Table 3). There were a total of 52 sites (109 when separated by sub-colonies) which ranged in size from 100 to 89,760 breeding pairs. Twenty-five of the sites had colonies $>1,000$ breeding pairs which accounted for 96% of the total population.

Figures 5 and 6 illustrate the distribution and relative size of colonies. Twenty-one percent of the colonies were found on East Falkland, and these colonies accounted for 8% (23,218 breeding pairs) of the total population. Similarly on West Falkland, 14% of the colonies contained 3% (7,582 breeding pairs). On the outer islands however, 65% of the colonies contained 89% (240,714 breeding pairs). These sites are all in areas of steep terrain. Lafonia (south of East Falkland) which is relatively flat, has no colonies of Rockhopper Penguins. The majority of colonies and birds are found on the outer islands, with the size of the colony generally being consistent regardless of geographical area. However, it is worth pointing out that of the island colonies, 74% of the total population (200,794 breeding pairs) can be found on 3 islands, Steeple Jason (89,760 breeding pairs, 33%), Beauchêne Island (61,651 breeding pairs, 23%) and Grand Jason (49,383 breeding pairs, 18%). For interest, 81% of all Rockhopper Penguins nest in mixed colonies with Black-browed Albatross.

Note: To our knowledge only two colonies of Rockhopper Penguins were not counted during the 2000/01 census, these were the Carcass Ridge colony (Coast Ridge Farm) and the New Island South Wildlife Reserve colony.

The italicised sites in Table 3, which contain the largest colonies (Steeple Jason, Beauchêne Island, Grand Jason and Bird Island), have been closely examined in terms of methodology for the 1995/96 census data. Furthermore, the Rockhopper populations on both Beauchêne Island and Steeple Jason were assessed previously in 1980/81 and 1991/92 and 1987/88, respectively, and therefore all data relevant to these sites was re-examined.

1) **Beauchêne Island**

The first complete census of Beauchêne Island was conducted in December 1980 by P.Prince (Lewis Smith & Prince, 1985). The method used was similar to the transect method explained above. The only difference being that colony sizes were estimated from aerial photographs rather than from measuring perimeters on the ground. He estimated that colonies covered 230,239 metres square, and around 300,000 breeding pairs of birds, at a density of 1.30 birds per square metre. The island was again visited in December 1991 and November 1995. During these visits, colony sizes were assumed to be the same as in 1981 and only nest densities were recorded. From the present study it can be clearly seen that this was an incorrect assumption and that over the years both density and colony size changed. As colonies dramatically decreased in size, the total number of breeding pairs on Beauchêne Island was over estimated. In an attempt to correct these estimates and by the lack of intermediate measurement of colony size, it was assumed that the decrease in colony size was linear between 1981 and 2001. Results are shown in Table 4 and Figure 7. It is important to note here that the corrected numbers of breeding pairs in 1991/92 and in 1995/96 were calculated in different ways. For the 1991/92 data we knew the densities for the individual areas and so could assess the numbers of breeding pairs more accurately using both corrected areas and individual densities, whilst for the 1995/96 census we only had an overall density of nests to use.

From Table 4 it can be seen that the overall decrease in breeding pairs of 79% (of original number) over a period of 20 years is due to both the colonies diminishing in size (by 24%) and nest density (from 1.3 to 0.36 nests per m²). The total number of breeding pairs was not found to be higher, in any of the intermediate years, than that found in the original census, although a count in the mid 1980s would have been highly enlightening. Changes in colony area were not homogenous throughout the island. The worst affected area was area D (southern part, see Appendix 1). Although there is a high variation in densities between years and areas, no trend was detected.

The pattern of densities in area A (largest) was interesting however. This long narrow colony exhibited a pattern of densities in 4 bands between the seaward side and the landward side. Adjacent to the sea the first band which was around 100m wide, had a density of around 0.48 nests per m², next to this band was an area completely empty of Rockhopper nests (Black browed Albatross were present only). The third band was again around 0.48 nests per m² and immediately adjacent to the tussock, the density was around 1.64 nests per m². This pattern was not observed elsewhere on the island, and was probably due to shape of these other colonies.

Further confirmation that the colony sizes and nest densities have changed was found by comparing closely black and white photographs taken by Ron Lewis-Smith taken in 1980 (Lewis-Smith & Prince, 1985), and those taken by Nic Huin in 2000. These photographs clearly show that parts of the colonies have shrunk, with some of the abandoned parts already re-colonised by tussac plants (Appendix 2a - shows a recent picture at the top and a picture of the same area taken twenty years ago below). The decline in nest density can

also be clearly seen in Appendix 2b, recent picture at the top and the same area twenty years ago, below.

2) Steeple Jason Island

The first census work was carried out by Kate Thompson in December 1987 (Thompson & Rothery 1991). She used the same method as P. Prince (1981) for Beauchêne Island. She estimated that the colonies covered 317,81 m². Birds bred within these colonies at an average density of 0.598 nests per m², giving an estimated total breeding pairs of 190,000 (Table 5). During the census of 1995/96 only nest density was recorded, and colony area assumed to be the same as in 1987/88. Results from our recent census illustrate that the colony area did in fact decrease. Thus, the values for population size were over estimated in 1995/96. As for Beauchêne Island, if it is assumed that the decrease in colony size was linear, a corrected area and population size for 1995/96 can be obtained (Table 5). Thus the colony area would have been 263,462 m², with an average density of 0.362, giving a total of breeding population of 95,373 breeding pairs. From this year's census we can see that the colony area decreased by 28% to an estimated 229,500 m², with an average density of 0.37 compared to 0.598 nests per m² in 1987/88 (Table 5, Figure 8). Although density varied between colonies and years, no trend was detected. On average density was lower than that measured on Beauchêne Island. Comparing this year's figures with the ones of 13 years ago, there has been an overall decrease of 53%, from 190,000 pairs to 89,760 pairs.

3) Grand Jason Island

Colonies on this island were first estimated in the 1995/96 census. The total number of breeding pairs was found to be 34,000 and no details of methods used were provided. During our recent census a full and accurate count was made using both direct count and area and transect methods. The results indicated a 45% increase in population size to 49,383 breeding pairs (Table 3, Table 6).

Table 6. A summary of colony area, nest density and total numbers of nests on Grand Jason 2000/01.

Colony	Area m ²	Nest density nest/m ²	Size	Direct count	Total Nests
Eastend					
Top big	5,451.93	1.135	6,185		6,185
Top little				627	627
Bottom				1,122	1,122
Flat top				2,931	2,931
Big bottom	22,875.96	0.991	22,665		22,665
Middle Big				4,505	4,505
Western Complex					
Far west				373	373
Rest				10,975	10,975
Overall	28,327.89		28,850	20,533	49,383

We feel that the results from 1995/96 should be treated with caution for a number of reasons. Firstly, it is strange that at the other two main sites (Beauchêne Island and Steeple Jason) both the Black-browed Albatross and the Rockhopper Penguins were counted (as on the whole they nest together) when researchers visited these islands. Secondly, the fact the Steeple Jason is very close to Grand Jason and the colony there decreased by 3% and yet on Grand Jason the colony increased by 45%. It might be that the Grand Jason colony was guessed rather than accurately measured in 1995/96, thus resulting in an over-estimation of size.

Bennett Data (Pütz, Huin & Clausen, *unpublished*)

Prior to Kate Thompson's visit to Steeple Jason in 1987/88, estimated population figures for the Jason Island group were 2.6 million breeding pairs, out of a total of 3 million for the whole of the Islands (Bennett, 1933). This high value was based exclusively on an area/density calculation, and any small mistake would have resulted in large errors for the total figure. When Nic Huin visited the Jason group in 2000/01 he found that the area Bennett based his calculation on would stretch up the steeple mountain and go over onto the north slope on Steeple Jason, and similarly on Grand Jason. There is no sign on either of the islands that such huge colonies previously existed (N.Huin & K.Pütz pers.comm.). On both Steeple Jason and Grand Jason the length of the colonies is still exactly as Bennett measured (2.5 miles and 1 mile, respectively). When the width given by Bennett is adjusted by one order of magnitude (from 900 yards to 90 yards for Steeple Jason and 800yards to 80yards for Grand Jason) the colony areas appear more realistic (361,206 m² and 117,726 m² for Steeple and Grand respectively). Bennett never actually visited the Jason Islands, but had estimates of areas made and used nest density figures slightly below the average found at other mainland colonies (around 0.5 nests per m²). When we use these re-calculated areas and a nest density of 1.302 nests per m² (from Beauchêne Island 1980/81) the Steeple and Grand Jason colonies were approximately 470,000 and 153,000 pairs respectively. Thus the total population for the Falkland Islands was probably closer to 1 million breeding pairs in 1932/33, rather than the 3 million pairs previously estimated).

As a result of the above we do not use the 1933 data collected by Bennett for comparison with recent results.

4) Bird Island

Colonies on this island were first estimated in the 1995/96 census. The total number of breeding pairs was found to be 10,600 and no details of methods used were provided. During our recent census a full and accurate count was made by direct count. The results indicated a 26% decrease to 7,858 breeding pairs (Table 3). As for Grand Jason we feel that the results from 1995/96 should be treated with caution. Firstly, it is strange that again there was no count of Black-browed Albatross made, when the colonies were mixed. Secondly, at the next closest site (Stephens Peak, Port Stephens) the colony has increased by 3%.

Population Trends

For penguin populations on the Falkland Islands we can now see that the King Penguin colony has declined slightly, but this is following a rapid increase since the early 1980's when just 38 pairs were nesting. Prior to this King Penguins breeding in the Falklands were exterminated by sealers during the 1800's, when they were killing penguins for oil. All King Penguins were gone by 1870 (Williams, 1995).

Gentoo Penguins are currently increasing in number, with a 75% increase since the previous census in 1995/96. Prior to that, an estimate of 116,020 pairs was made by Bennett (1933). So there was clearly a decline in numbers during the 19th century, but due to a lack of intermediate data it is impossible to say when exactly the decline occurred. However, both the collection of eggs and rendering down of birds for oil by the sealers will have contributed substantially to the decline.

Rockhopper Penguins in the Falkland Islands now appear to be stable or increasing. There has clearly been a substantial decline since the early 1900's, and circumstantial evidence suggests that Rockhopper populations were around 500,000 breeding pairs in the early 1980's prior to the crash in 1985/86. If the recalculation of Bennett's data is close to accurate, the population had declined by 50% from the 1930's to the 1980's, and the crash in 1985/86 further reduced the population so that there has been an overall decline in population size by 75%. The crash in 1985/86 was a result of starvation (Keymer, 1988), but due to the lack of information regarding the diet it is impossible to conclude anything specific other than the prey was unavailable. Reasons for the decline prior to 1985/86 are unknown, although the collection of penguin eggs by the local population and the rendering of birds for oil by the sealers will have had a considerable impact. At the present we can conclude that the population is stable at 272,514 pairs.

World Status

King Penguins

All populations for which there is current data available are increasing (Woehler & Croxall, 1997). Table 7 summarises the status of the main populations, including the Falkland Islands.

Table 7. Population status of King Penguins *Aptenodytes patagonicus*.

Site	Size (pairs)	Date	Status	Source
Crozet Group	700,000	1992	increasing	Woehler & Croxall, 1997
Heard Island	16,345	1993	increasing	Woehler & Croxall, 1997
MacQuarie Island	110,000	1997?	increasing	Woehler & Croxall, 1997
South Georgia	400,000	1997?	increasing	Woehler & Croxall, 1997
Falkland Islands	500	2000	increasing	this report

Gentoo Penguins

There are large fluctuations in populations at all sites (Woehler & Croxall, 1997). Some sites have increased by between 20 and 40% whilst at some other sites there have been decreases over the past decade (Table 8).

Table 8. Population status of Gentoo Penguins *Pygoscelis papua*.

Site	Size (pair)	Date	Status	Source
Prince Edward Islands	1,310	1995	stable	Woehler & Croxall, 1997
Heard Island	13,415	1992	decreasing	Woehler & Croxall, 1997
MacQuarie Island	6,820	1992	increasing	Woehler & Croxall, 1997
Antarctic Peninsula	22,368	1994	increasing	Woehler & Croxall, 1997
South Shetland Islands	2,336	1994	increasing	Woehler & Croxall, 1997
South Orkney Islands	10	1994	decreasing	Woehler & Croxall, 1997
Falkland Islands	112,771	2000	increasing	this report
South Georgia	90,000	1995?	stable/decreasing	Williams, 1995
Kerguelen Island	35-40,000	1995?	stable/decreasing	Williams, 1995

Rockhopper Penguins

The population status of the Southern Rockhopper Penguin (*Eudyptes chrysocome chrysocome*) is currently stable. There is new data from Staten Island, which holds populations totalling 173,793 pairs. Both the Chilean and Falkland Island populations are stable/increasing.

Populations of other Rockhopper species, *E.c.filholi* and *E.c.moseleyi*, are stable or decreasing (Williams, 1995).

Table 9. Population status of Rockhopper Penguins *Eudyptes c.chrysocome*

Site	Size (pairs)	Date	Status	Source
Staten Island	173,793	1998/9	new	Schiavini, 2000
Southern Chile	164,800	1998	stable	Schiavini, 2000 (recalc.)
Falkland Islands	272,514	2000	stable/increasing	this report

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REFERENCES

Bennett, A.G. (1933) The Penguin Population of the Falkland Islands in 1932/33. Government Press, Falkland Islands. 4pp.

Bingham, M. (1998) The distribution, abundance and population trends of gentoo, rockhopper and king penguins in the Falkland Islands. *Oryx* 32:223-232

Falklands Conservation Report No.1 Census of the Black-browed Albatross Population of the Falkland Islands by Nic Huin. (2001) 20pp.

Keymer, I. (1988) An investigation of Rockhopper penguin *Eudyptes c.chrysocome* mortality in the Falkland Islands during the 1985-1986 breeding season. Falkland Islands Foundation Report, WWF, UK.

Lewis-Smith, R.I. & Prince, P.A. (1985) The natural history of Beauchêne Island, Falkland Islands. *Biological Journal of the Linnean Society*, 24:233-283.

Prince, P.A. (1981) The Black-Browed Albatross *Diomedea melanophrys* population at Beauchêne Island, Falkland Islands. *Comité National Francais des Recherches Antarctiques* 51:111-117

Pütz, K. Huin, N. & Clausen.A.P. A re-evaluation of Penguin population figures from 1992/33. (unpublished)

Schiavini, A. (2000) Staten Island, Tierra del Fuego: the largest breeding ground for Southern Rockhopper Penguins. *Waterbirds* 23:286-291

Thompson, K.R. & Rothery, P. (1991) A Census of the Black-Browed Albatross *Diomedea melanophrys* Population on Steeple Jason Island, Falkland Islands. *Biological Conservation* 56:39-48

Williams, T.D. (1995) *The Penguins*. Oxford University Press. 295pp.

Woehler, E.J. & Croxall, J.P. (1997) The status and trends of Antarctic and sub-Antarctic seabirds. *Marine Ornithology* 25:43-66