Preliminary results of a Southern Royal Albatross *Diomedea epomophora epomophora* census, Campbell Island, 12 January–10 February 1995

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Abstract

A census of breeding Southern Royal Albatross was undertaken at Campbell Island during the period 12 January to 10 February 1995. 6308 occupied nests were counted. Comparisons of different field census techniques and a measure of the rate of egg loss suggest that 6900–7300 pairs were nesting in 1995.

1. Introduction

The Southern Royal Albatross, *Diomedea epomophora epomophora*, breeds almost exclusively on Campbell Island 52° 33' S 169° 09' E (Marchant & Higgins 1990). Numbers of Southern Royal Albatross have been assessed during surveys carried out during the incubation period, at irregular intervals since 1958 (Appendix 1). Surveys between 1969 and 1983 recorded between 4208 and 5336 pairs breeding annually (Taylor *et al.* 1970; Dilks & Dunn 1978; Dilks & Wilson 1979; Wilson & Elliott 1981, Dilks & Grindell 1983). Counts were made in several consecutive years during this period, and for the purposes of the counts the island was divided arbitrarily into 10 survey blocks (Fig. 1; Dilks & Wilson 1979). The species is a biennial breeder which means that birds that are successful breeders usually return to breed two years later, whereas birds that fail at the egg or early chick stage, usually return the following year. Thus, a series of annual counts combined with information on breeding success and breeding frequency are required to interpret population trends. Detailed surveys of numbers of occupied nests were conducted at two study areas, Col and Moubray, which are smaller parts of the larger survey blocks (Fig. 1), in 1988 (Moore & Moffat 1990), and annually since 1992 as part of a programme to monitor breeding success.

It is possible that a number of factors may be influencing the population dynamics of albatrosses in the Southern Ocean region and on Campbell Island itself. In the 12 years since the 1983 count, concern had risen over the impact of fisheries bycatch mortality on various albatross populations around the world (Weimerskirch & Jouventin 1987; Croxall *et al.* 1990; Brothers 1991) and in the New Zealand region (Bartle 1991; Murray *et al.* 1993). In addition, environmental change has been indicated as a possible cause of the declines of marine-dependent species populations in the subantarctic. For example, sea-surface temperature change was thought to be influential in the dramatic decline of Rockhopper Penguins, *Eudyptes chrysocome*, at Campbell Island, where the population declined by 94% between the 1940s and mid 1980s (Cunningham & Moors 1994). There have been significant and continuing changes to the vegetation of Campbell Island since sheep (*Ovis aries*) were systematically removed from parts of the island between 1970 and 1990 (Meurk 1982, 1991; Meurk *et al*. 1994), so the nesting distribution of albatrosses may have changed.

The census conducted in 1995 was motivated by the need to re-establish the population trend base-line to assess what changes may have occurred since 1983. It was planned that

the census be the first in a series of annual counts, necessary to estimate the current breeding population size.

A team of four people (two full-time and two part-time) carried out a census of nesting Southern Royal Albatross on Campbell Island from 12 January to 10 February 1995. Additional observations were made by one of us (G.M.) before and after the main survey period.

This report summarises results of the census.

2. Aims

1. Conduct an accurate census of Southern Royal Albatross nests on Campbell Island.
2. Compare various counting methods.

3. Methods

Three methods of counting Royal Albatross nests were employed. These have been termed: "intensive nest count", where an effort was made to find every nest within study areas; "ground search", where as many nests as possible were counted within the time constraints of the census; and "vantage point" surveys, where nests were counted from viewpoints. Nesting albatrosses are spread sparsely across the tussock grassland meadows dominated by *Poa litorosa*. This zone is between the upper edge of the *Dracophyllum* scrub zone (150–200 m a.s.l.) and the high alpine tundra mosaics (350–400 m)(Meurk & Given 1990).

3.1 INTENSIVE NEST COUNT

In this method, every nest was searched for and marked in the two study areas. On the initial visit, the country was covered by intensively zigzagging through the area, revisiting nests from different directions to make sure none were missed, and searching peripheral zones (e.g., the upper edge of the scrub zone). On subsequent visits, the gaps between nests were checked for other nests that may have been missed. In this way, almost all the nests in an area would have been found, apart from nests that may have failed between egg laying and the first visit.

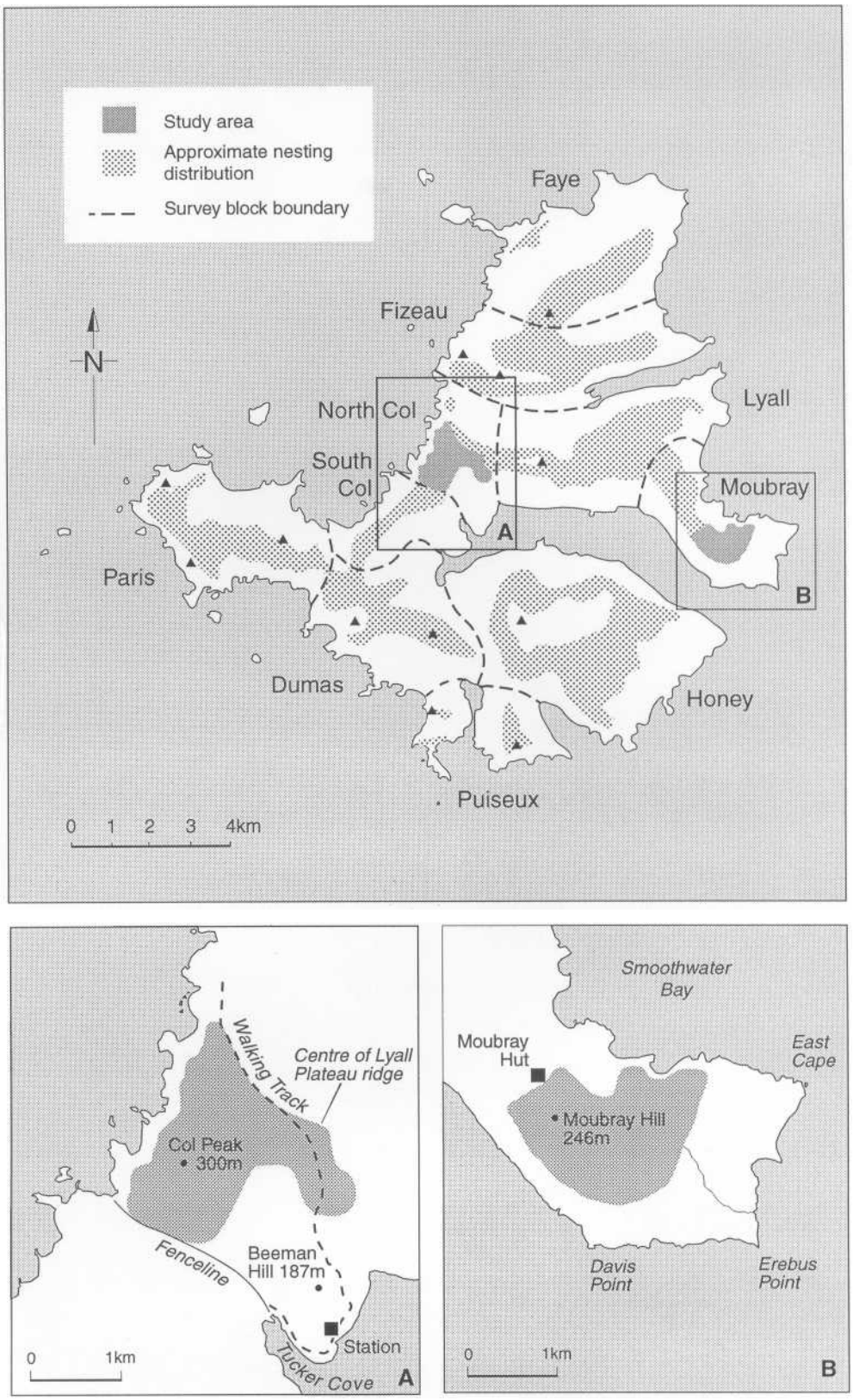

FIGURE 1. SOUTHERN ROYAL ALBATROSS SURVEY AREAS AND APPROXIMATE NESTING DISTRIBUTION ON CAMPBELL ISLAND, 1995. A = MOUBRAY STUDY AREA, B = COL STUDY AREA.

3.1.1 Col study area

The Col study area (Fig. 1) was searched (by G.M.) for nests on six days between 23 December 1994 and 13 January 1995. Nests were marked with small metal tags. Some tags were later replaced by orange PVC piping to make obscured nests easier to find. Several subsequent visits were made to the area up until 10 February to recapture and band breeding birds. All bands were checked at least twice on different visits, to reduce errors arising from misreading of bands.

The relative positions of nests were measured using compass bearings and by pacing distances between neighbouring nests. This was to assist with re-finding of nests and to provide a measure of nest distribution in the study area. Bill measurements (culmen length and three bill depth measurements) were taken from a selection of birds in order to sex them.

Further visits were made (by G.M.) in March and August to the study area, to determine the rate of breeding success.

3.1.2 Moubray study area

Searches for nests in the Moubray study area (Fig. 1) were made by three people on 15–16 January 1995. Nests were marked with small metal tags or orange pipe where they were obscured by vegetation or by the terrain. The band numbers of breeding birds were recorded, but no new bands were applied. A further visit by two people on 30–31 January was made to map the approximate positions of 204 nests in the centre of the study area.

The problem (as noted by previous workers) of bands which have been applied badly, or have sprung open, was also found in this survey. This required adjustment of bands on some birds or, if a band was digging into a leg, the transfer of the band to the other leg. Bands were moved to the other leg on three non-breeders at Col and two non-breeders at Moubray. Two breeders had scars in their legs, indicating a band had been removed in previous years.

3.2 GROUND SEARCH

Because of time constraints, it was not possible use the intensive nest count method over the whole island, so the less intensive ground search was used for the census. It was intended that the method would be similar to previous census methods (Taylor *et al*. 1970, P. Dilks, pers. comm.), however, not enough information was available on the amount of effort used or the relative use of searching by foot versus viewpoints to exactly reproduce the methods. The island was divided into the ten arbitrary blocks that were used in previous surveys (Fig. 1), and the census was conducted during the period 12 January to 10 February 1995 (Note that eggs are laid in late November to early December and chicks hatch in mid to late February; Sorensen 1950). Fog or high winds in higher altitude areas disrupted or prevented counts on several days.

The ground search survey method involved searching areas systematically on foot, in order to find the majority of nests. The idea was to choose an optimal coverage of the area that would minimise nests being missed or counted twice. Usually an initial viewpoint was used to assess the extent of the nesting area. The survey of that area combined searching for nests by zigzagging the countryside, while using prominent

ridge-lines, edges of gullies, edges of terraces and hillocks from which to view small areas from above. Peripheral areas, such as the scrub margin, were searched if birds were visible from above or forays into the zone revealed nests were present. The way a particular area was surveyed depended on the terrain type and the number of personnel available on the day. Areas of even terrain or uniform terraces were searched by making parallel zigzags along the contours, while noting geographical features to avoid counting birds twice from different altitudes. This was done by one person doing several sweeps or two to three people walking in parallel, within earshot or radio contact. The distance between sweeps, or people, was up to 100 m for very easy country (i.e., nests were not obscured), 20–50 m for denser tall tussocks or uneven ground, down to < 20 m for scattered scrub. For some terrain types, such as narrow ridge/gully systems, it was more efficient to walk up and down the slope.

During ground searches, birds were counted if they were sitting on a nest with a posture suggesting they were brooding an egg (sitting tight with a profile that was smooth with the nest bowl). Birds that were sitting on nests without eggs, or on the ground, were excluded from the count, and were distinguished by approaching them to make them stand up, by the lack of a proper nest, or by the posture they adopted (birds without eggs usually sat with their folded wings and posterior slightly raised). It was expected that ground searches would be less accurate than intensive nest counts, as some obscured nests would be missed, some nests would be counted twice from different angles and some non-breeders might have been mistaken for nesting birds.

3.3 VANTAGE POINTS

During the census, some larger areas were searched using binoculars from an adjacent hillside. This was used when the vantage point gave unobstructed views of steep slopes that were less than two km away, and that were known to have been counted in the same manner previously (P. Dilks, pers. comm.). Generally, this method was not favoured because of the chance of missing obscured birds, or counting non-breeding birds, and the difficulties of defining boundaries with areas that were later to be counted on foot. The main areas surveyed by binoculars were the western pocket of nests in Faye (as viewed from Faye ridge), the northern and southern slopes of Mt. Fizeau (viewed from Faye and Lyall ridges), and a basin on the southern slopes of Lyall ridge (from either side of the basin).

In addition, a count from vantage points was made on 17 December 1994, to make an initial, coarse estimate of the numbers of birds nesting at Col study area. It was expected that this would be less accurate than the ground search, as hidden nests would not be seen.

3.4 COMPARISON OF SURVEY METHODS

A limited comparison was made of the three methods of population survey described above. Unfortunately, there was insufficient time for many replications of counts.

It was assumed that the "intensive nest counts" were as close as possible to representing the total number of nests. Therefore, the intensive nest counts at the Col and Moubray study areas formed the basis for our comparison with the more coarse survey methods.

The "vantage point" count of the Col study area on 17 December 1994 was used to test the potential accuracy of that method, but the larger binocular counts were not compared.

At the Col study area, a "ground search" was carried out by two observers who had not taken part in the original "intensive nest count" of the area. At the Moubray study area, a "ground search" was undertaken by two observers that had been involved in the original "intensive nest count", but were not familiar with the whole area; and the two workers operated singly. The two comparisons had different terrain types - Col study area consisted of smooth, tussock-covered slopes across a steep ridge, and the Moubray area was dissected by small gullies, with a margin of scrubby vegetation.

4. Results

4.1 I NTENSIVE NEST COUNTS

4.1.1 Col study area

During the initial search period of the "intensive nest count", 23 December 1994 to 13 January 1995, 193 nests were found. This was effectively the first visit to each sector of Col. Another five nests were found on subsequent visits (2-6 revisits depending on the sector, up to 7 February 1995) to the main Col study block, and five more were added to the Lyall Plateau boundary, outside the initial search area; i.e., 203 nests in total. (NB. there has been some confusion over the years about where the Lyall Plateau boundary is. This is because the centre of the ridge (Fig. 2) is not an obvious feature. Consequently, 14 nests were marked that were over the arbitrary line and 189 nests were in the Col study area proper. In future years the boundary will be marked with poles).

Both partners were identified at 193 nests, with the remainder having failed and been abandoned before both birds were seen. Ten nests failed during the study period: three failed between 12-20 January; three by 27 January; three between 27 January and 4 February; and one failed around 4 February.

About 30 hours were spent by one person (with some help from Met. Station staff) on six days doing the initial search of the Col study area. There were

several further visits to the area to find nest partners, but the amount of effort was not recorded.

4.1.2 Moubray study area

During the initial search of the "intensive nest count" at Moubray study area on 15 January 1995, 487 nests were found. One other nest was found on the second visit on 29 January, and a second was identified at the chick stage in August. Three nests out of 204 had failed between the first two visits.

The initial search took four people a total of 54 hours, on two days. Two further days were spent by two people mapping nest locations in part of the area.

4.2 CENSUS

A total of 6308 Southern Royal Albatross nests was counted using the "ground search" method, supplemented by "vantage points", for the 10 survey blocks on Campbell Island (Fig. 1), between 12 January and 10 February. All birds were incubating.

There was an increase in number of nests recorded of 49% between 1983 and 1995, with the proportional change at individual blocks varying between 14-83% (Table 1).

The count took 193 person hours (24 person days) on 11 calendar days to complete, with the equivalent of three full time workers (two half-time, two full-time). Travel times are excluded from this 193 hours, but are substantial with two or more hours walk each way to reach some blocks.

TABLE 1. NUMBERS AND DISTRIBUTION OF SOUTHERN ROYAL ALBATROSS NESTS ON CAMPBELL ISLAND, JAN-FEB 1983 AND JAN-FEB 1995.

SURVEY BLOCK	AREA (ha) [1]	NO. NESTS COUNTED IN 1983 [2]	NO. NESTS COUNTED IN 1995	% INCREASE 1983-1995	PERSON HOURS 1995
Faye	1376	692	1072	55	39
Fizeau	1204	643	842	31	8
Lyall	1326	682	780	14	20
Moubray	787	509	905	78	22
North Col	604	139	213	53	12
South Col	466	127	222	75	10
Paris	1011	373	676	81	24
Dumas	1194	301	495	64	18
Honey	2300	717	993	38	34
Puiseux	570	60	110	83	6
TOTAL	10,838	4243	6308	49	193

[1] Total area of block, including altitudinal zones not surveyed for albatross (Dilks & Wilson 1979).
[2] Dilks and Grindell 1983.

4.3 COMPARISON OF SURVEY METHODS

4.3.1 Intensive nest count

"Intensive nest counts" were the basis for our comparison with the more coarse survey methods. However, it is possible that nests were overlooked during the multiple visits.

It is important to note that in future surveys all study nests need to be clearly marked. The initial use of small metal tags, which often were lost or obscured by vegetation, caused problems of confusion between nests, particularly when nests failed.

4.3.2 Vantage point

A count from vantage points was used to make an initial estimate of the numbers of birds nesting at Col study area on 17 December 1994. The count of 146 nests was only 72-77 % of the numbers (189-203) counted during "intensive nest counts", depending on which boundary of the Lyall Plateau was used.

4.3.3 Ground search

A ground search by two people at Col study area located 164 nests, which was 87 % of the total (189) known from the "intensive nest count". The search took five hours to complete (10 person hours), compared with 30 hours for the original "intensive nest count".

At Moubray study area, 466 nests were counted using the ground search method, in an area where there were at least 489 nests. It was assumed that 489 had decreased to 482 nests, as three out of 204 (1.4%) in the Moubray study area had failed between the initial search of the "intensive nest count" and the ground search. Therefore, about 97 % of nests were located. The ground search by two people took 10 person hours, compared with 54 person hours spent on the intensive nest count.

4.4 ESTIMATES OF TOTAL NESTING NUMBERS

Two correction factors (87%, 97%) were used to adjust the census figures (Table 2). These correction factors were obtained from the two comparisons of "ground search" versus "intensive nest count". This was to allow for underestimation of the number of nests during a "ground search" over the whole island. For areas that were perceived to have been surveyed less accurately, it was assumed 87% of nests were counted (e.g., difficult terrain; a patchwork of sectors on different days by different people; "vantage point" counts by binoculars at Fizeau and part of Lyall). For areas that were surveyed adequately, the range 87-97% was used. For areas where it was assumed very accurate counts were made (because of terrain type or personnel), it was assumed 97% nests were found (Table 2).

From 12 January to 12 February, 5.7% of nests failed at Col study area. It was assumed that nests were failing at a similar rate all over the island and that,

consequently, the raw counts would underestimate the number of nests present. Therefore, the failure rate at Col study area was used to further adjust the census figures to 12 January levels, depending on which dates each block of the island was counted (Table 2).

Thus, the census figure of 6308 nests was corrected to 6900-7300 nests present in mid January 1995 (Table 2).

TABLE 2. ESTIMATE OF NUMBER OF SOUTHERN ROYAL ALBATROSS NESTS PRESENT ON CAMPBELL ISLAND.

SURVEY BLOCK	DATE OF CENSUS	A: NO. NESTS COUNTED	B: ESTIMATED PROPORTION OF NESTS FOUND [1]	C: SUCCESS OF NESTS AT COL [2]	D: CORRECTED NO. OF NESTS D=(A/B)/C
Faye	19-20 Jan	1072	0.868-0.967	0.974	1138-1268
Fizeau	19 Jan	153	0.868	0.974	181
	24 Jan	254	0.868	0.964	304
	2-3 Feb	435	0.868	0.948	529
Lyall	22-24 Jan	294	0.868	0.964	351
	2 Feb	399	0.868-0.967	0.948	435-485
	5 Feb	87	0.967	0.943	95
Moubray study area	29 Jan	466	0.967	0.948	508
Moubray remainder	2 Feb	439	0.967	0.948	479
Col study area	13 Jan	164	0.868	1	189
N. Col remainder	13 Jan	49	0.868	1	56
S. Col	10 Jan	222	0.967	0.979	235
Paris	22-23 Jan	676	0.967	0.964	725
Dumas	23-24 Jan	495	0.868-0.967	0.964	531-592
Honey	26 Jan	993	0.868-0.967	0.964	1065-1187
Puiseux	24 Jan	110	0.967	0.964	118
TOTAL		6308			6939-7302

[1] Proportions of nests found at Col (0.867) and Moubray (0.967) during comparisons of the "ground search" and "intensive nest count".
[2] Proportion of nests successful at Col at the date of survey of the particular block.

5. Discussion

The census recorded a larger number of Southern Royal Albatross nests on Campbell Island than had been reported there before. However, these results should be considered with caution, primarily because the 1995 count in isolation is not sufficient to allow an estimate of the total breeding population of this biennially breeding species to be made. Further counts in the next three consecutive years will be necessary, along with an examination of breeding frequency, which will help establish a more reliable population estimate. After these counts have been completed, they can be compared with the previous census data, particularly the counts conducted in consecutive years between 1975–76 and 1980–81.

Although three survey methods have been described in this report, in reality they are a continuum in effort from "intensive nest count" to "ground search" to "vantage point" counts (although it is not certain where the binocular vantage points fall along this scale). It is assumed that the intensive nest counts are the most repeatable between surveys, and can be used to give correction factors to censuses using the other coarse methods. Unfortunately, there are few indications of the amount of effort used, the relative use of "ground searches" versus "vantage points" or the reliability of the previous surveys (e.g., Taylor *et al.* 1970, Dilks & Wilson 1979). Another problem is that the variable timing of the censuses in mid-late incubation allows no estimate of nest failure prior to the survey period.

The comparisons of survey methods carried out in this study indicated that vantage point surveys are of low accuracy (72–77%). We were not able to examine the variability in accuracy of this method, but we assume that it is high, depending on the visibility and terrain.

As "ground-searching" at Col study area found 87% of the known nests, this correction could be applied to areas of similar terrain around the island, but equally, it may have reflected the fitness or thoroughness of the particular personnel on that particular day. It was expected that the ground search method would find fewer nests than intensive nest counting, because nests that were hidden by vegetation or terrain were more likely to be missed.

The ground search at Moubray study area found a higher proportion of nests than that at Col — about 97% of the known number of nests. It had been expected that Moubray would be more difficult to count, as this area has complex terrain with high, scrubby vegetation in places. Factors which may have improved the accuracy were that the observers were being very thorough, they had gained experience during the census, had prior knowledge of the area (e.g., they knew which areas of the scrub to search), and were operating singly (i.e., they were less likely to confuse which sectors had been counted by another worker). Inclusion of non-breeding birds in the count, mistaken for nesting birds, could also have inflated the count. Conversely, the ground search at Col study area may have been of relatively poor accuracy for the terrain type.

Although an attempt has been made to assess the accuracy of the census in 1995 — something which was not done in previous censuses — much more replication of counts is required in future surveys before we can place true confidence intervals on the population estimates.

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APPENDIX 1. NUMBERS AND DISTRIBUTION OF SOUTHERN ROYAL ALBATROSS ON CAMPBELL ISLAND 1958–1995.

	AREA (ha)	1958[1]	1964–68[2]	1969[3]	1971[4]	1975–76[4]	1977[4]	1977–78[5]	1979–80[6]	1980–81[7]	1983[8]	1995[9]
Faye	1376	465	419	657		897	772	910	794	801	692	1072
Fizeau	1204	544	697	748		944	841	654	735	683	643	842
Lyall	1326	321	530	504		652	697	532	604	535	682	780
Moubray	787	233	400	569		694	561	593	485	567	509	905
North Col	604	59	137	148		230	185	156	172	167	139	213
South Col	466	39		59	123	139	129	94	94	90	127	222
Paris	1011	99	281	389	429	490	535	241	431	423	373	676
Dumas	1194	135	233	305	299	393	344	266	302	323	301	495
Honey	2300	365	473	897	804	814	775	696	914	846	717	993
Puiseux	570	18	46	68	54	83	67	66	44	58	60	110
Nth of fence		1622	2183	2626		3417	3056	2845	2790	2753	2665	3812
Sth of fence		656	1033	1718	1709	1919	1850	1363	1785	1740	1578	2496
Totals		2278	3216	4344		5336	4906	4208	4575	4493	4243	6308

Data Sources: [1] Jan–Feb 1958, Westerskov 1963; [2] Guard 1968 (boundaries between areas differ from other studies); [3] 8–26 Jan 1969, Taylor *et al.* 1970; [4] 31 Jan–10 Mar 1971, 12 Dec 1975–14 Feb 1976, 1 Jan–13 Feb 1977, Dilks and Wilson 1979; [5] 23 Dec 1977–31 Jan 1978, Dilks and Dunn 1978; [6] 23 Dec 1979–15 Jan 1980, Wilson and Elliott 1981; [7] 29 Dec 1980–7 Feb 1981, Foggo and Meurk in Wilson and Elliott 1981; [8] 14 Jan–11 Feb 1983, Dilks and Grindell 1983; [9] 12 Jan–10 Feb 1995.