Is onshore human activity a factor in the decline of the southern elephant seal?

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Comparison of areas of high and low human activity on Marion Island shows no difference in rates of decline of elephant seal numbers. Spatial distribution of births also shows no change in the period 1976 – 1986, suggesting that no shift in breeding population distribution has occurred in the period as a result of the level of human activity on Marion Island. Furthermore, comparisons of Marion Island with other breeding sites of elephant seals, where human activity is lower, show no significant differences in the rates of decline of the species. Direct onshore human disturbance is therefore rejected as a significant factor in the decline of the species.

Die vergelyking tussen areas van hoë en lae menslike aktiwiteit op Marion-eiland toon geen verskil in die tempo van afname in olifantrob-getalle nie. Geen verandering in die ruimtelike verspreiding van geboortes is tussen 1976 en 1986 waargeneem nie, en dit beteken dus dat die vlak van menslike aktiwiteit op Marion-eiland geen effek op die verspreiding van die eilandbevolking in die bepaalde tydperk gehad het nie. Wanneer ander olifantrobteelareas, waar menslike aktiwiteit laer is, vergelyk word met Marion-eiland, word geen noemenswaardige verskil in die tempo van afname in die spesies verkry nie. Dit volg dus dat direkte menslike versteuring as 'n betekenisvolle faktor in die afname van die spesies verwerp kan word.

Introduction

The southern elephant seal, *Mirounga leonina*, population of Marion Island forms part of the Kerguelen stock of the species (Laws 1960). The breeding population is in a state of decline (Skinner & van Aarde 1983) as are those of all the southern Indian Ocean breeding colonies (Burton 1986, van Aarde 1980, Barrat & Mougin 1978), and that on Macquarie Island (Hindell & Burton 1987). Research is currently in progress on Marion Island to identify possible forces contributing to the decline.

Unlike the other islands where declines are in progress, weekly counts have been made of breeding animals on the northeast coast of Marion Island for the past 14 breeding seasons. Thus, part of the population has been exposed to a higher level of human disturbance than elsewhere on the island. This paper examines the possible negative effects of human disturbance by comparing the frequently visited area with beaches elsewhere on the island which were not regularly visited.

Methods

Adult cows, weaned pups and dead pups were counted at breeding beaches along the Marion Island coastline from 25 October – 2 November 1976 and 24 October – 2 November 1986. Counts at these times enable accurate assessment of total pup production. In addition, the earliest observation of any pup movement between beaches in 1986 was made on 14 November, and in previous years on 12 November. It can, therefore, be accepted that all weaned pups counted on a particular beach were born at that site. All cows have, by this date, hauled out to give birth and thus no adjustment is required to determine total numbers of cows hauled out for the season. By combining numbers of cows ashore with counts for weaned and dead pups a figure for total pup production can be estimated. This method assumes that a) all cows hauling out give birth to a pup, b) each weaned pup ashore represents one cow, c) each dead pup represents one cow and d) mothers of weaned and dead pups have departed from the colony.

For the purposes of the present study, the island was divided into two sectors. The first sector included the coastline between Ship's Cove and Archway Bay (Fig. 1) which was, between 1976 and 1986, the focal area for a tagging programme, and was counted weekly during each breeding season. At each occasion harems were closely approached to facilitate accurate counting, inspection of cows along the periphery for tags, and to mark all recently weaned pups. This frequently resulted in considerable disturbance (see Discussion). The second sector comprising the remainder of

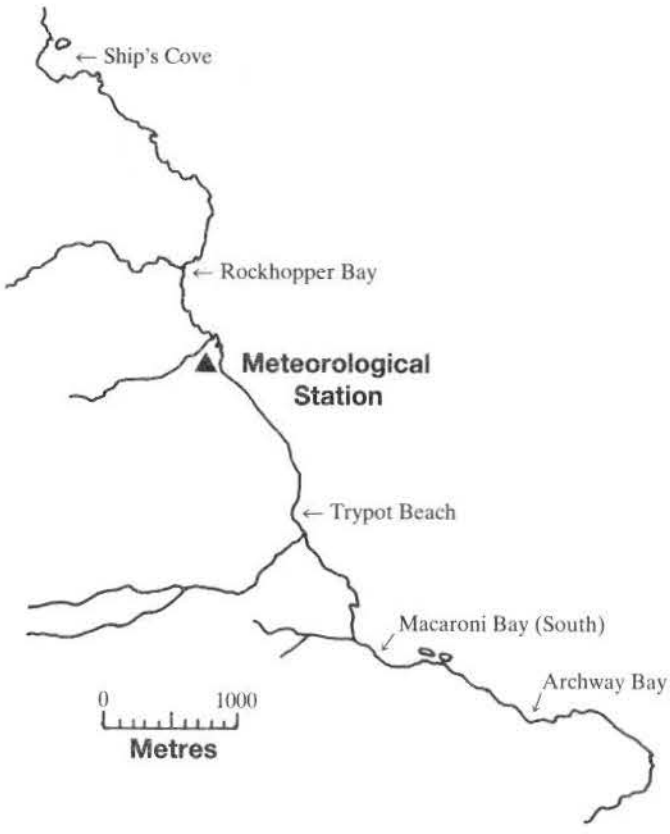

Fig. 1. 'High' disturbance area on North East coast of Marion Island.

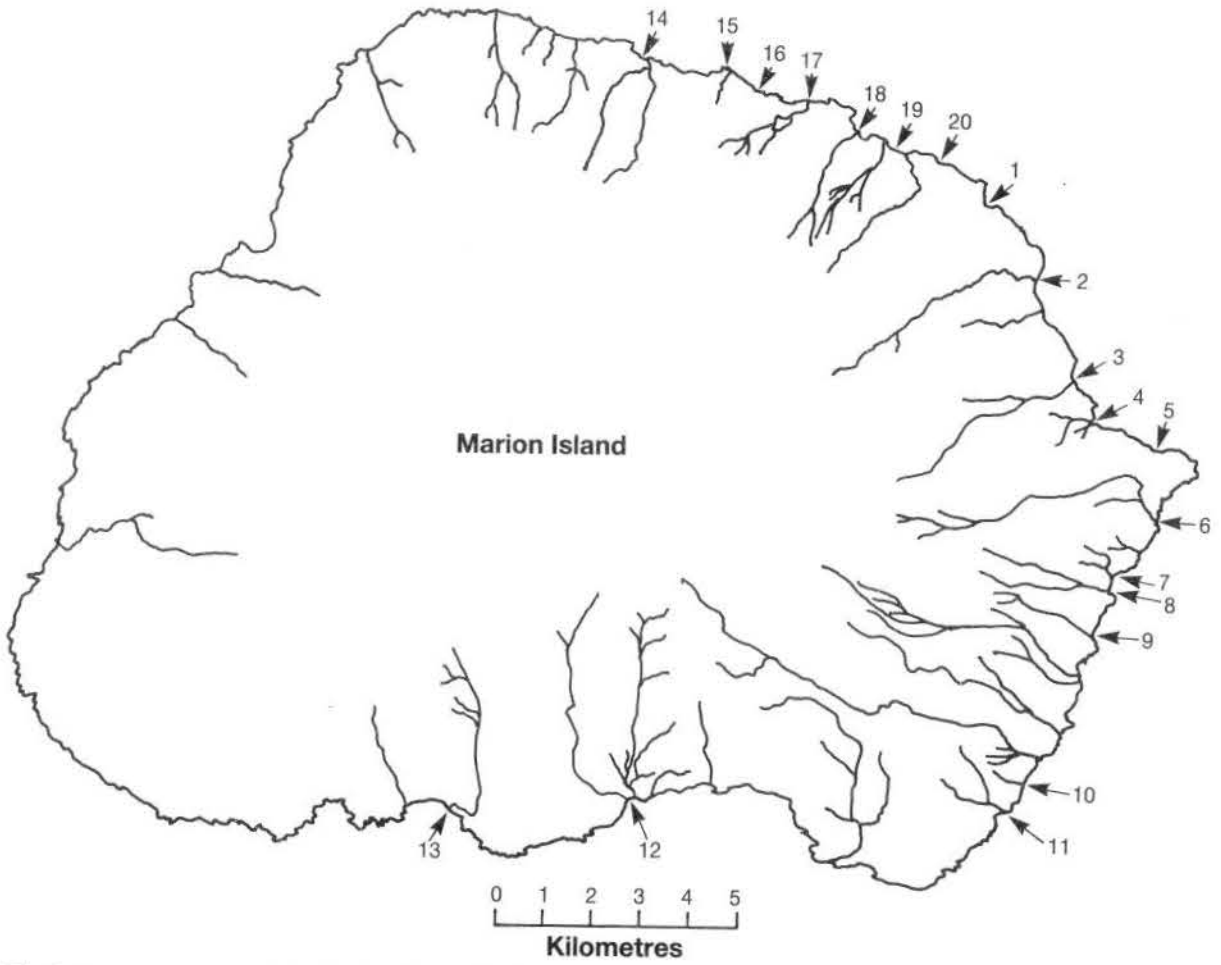

Fig. 2. Map of Marion Island showing beaches used in the present study (for details refer to Table 1).

Table 1

Pup production of *M. leonina* on beaches with 'high' and 'low' levels of direct human disturbance at Marion Island in 1976 and 1986, and intrinsic rates of increase or decrease (r) over the period. Pup production is estimated from combined counts of cows, weaned pups and dead pups.

Beach	1976	1986	r
'High'			
*1 Ship's Cove	53	51	−0,004
2 Rockhopper Bay (mouth of Van den Boogaard River)	13	4	−0,118
3 Trypot Beach	59	58	−0,002
4 Macaroni Bay (South)	53	16	−0,120
5 Archway Bay	106	60	−0,057
Mean			−0,060
'Low'			
6 Hansen Point	11	3	−0,130
7 Bullard Beach North	41	19	−0,077
8 Bullard Beach South	20	22	+0,010
9 Killer Whale Cove	14	10	−0 034
10 Funk Bay	73	14	−0,165
11 Kildalkey Bay	97	57	−0,053
12 Watertunnel Stream	51	39	−0,027
13 Goodhope Bay East	66	41	−0,048
14 Storm Petrel Bay	13	3	−0,147
15 Goney Beach	50	77	+0,043
16 Log Beach/Prinsloomeer	6	2	−0,110
17 King Penguin Beaches	69	69	0,000
18 Pinnacle Beach	44	43	−0,002
19 Blue Petrel Bay	34	24	−0,035
20 Sealer's Beach	66	38	−0,055
Mean			−0,060

*Site references to Figure 1.

the coastline (Fig. 2) was exposed to 'low' levels of disturbance with intermittent visits, usually two, made during each breeding season.

Beaches in the 'high' and 'low' disturbance areas are shown in Table 1 with the pup totals for the two years. Analysis of population trends was based on an intrinsic rate of natural increase or decrease (r) contained in the exponential function:

$N_t = N_o e^{rt}$ (Caughley 1977).

The percentage of island pup production occurring in the 'high' disturbance area is compared for the two years (Table 2).

Counts of dead pups on all beaches allowed a comparison between pre-weaning mortality rates in the two areas.

Table 2

Pup production in 'high' disturbance area expressed as a percentage of total island pup crop.

Year	Pup production in disturbed area	Pup production on whole island	% of island pup crop
1976	297	1114	26,7 %
1986	189	735	25,7 %
			$\chi^2 = 0,20$, $P > 0,05$

Results

Pup production in 1976 was estimated at 1 114 while in 1986 the total was 735. This gives an intrinsic rate of decline of 4,2 per cent per annum. The estimated pup production in 1951 (Rand 1962) was 3 662 thus giving a rate of decrease between 1951 and 1976 of 4,8 per cent per annum.

Pup production on beaches in both the 'high' disturbance area (n=5), and those in the 'control' area (n=15) showed a mean rate of decrease of 6 per cent per year for the period 1976 – 1986.

The spatial distribution of pup births did not differ in the two years in question ($\chi^2 = 0,20$, df = 1, $P > 0,05$). In 1976, 297 of the island's 1 114 pups (26,7 %) were born in the disturbed area while in 1986, 189 of 735 (25,7 %) were born in the area.

The levels of pre-weaning mortality (Table 3) did not differ in the two areas in 1986 ($\chi^2 = 0,63$, df = 1, $P > 0,05$).

Table 3

Pre-weaning mortality in 'high' and 'low' disturbance areas during 1986.

Disturbance level	Births	Deaths	% Mortality
'high'	189	7	3,7 %
'low'	546	28	5,1 %
			$\chi^2 = 0,63$, $P > 0,05$

Discussion

Human disturbance could exert its effects on the population in a number of ways.

1. Disruption of suckling patterns and hence reduced energy transfer to pups, lighter weaning weights (Bryden 1968) and possible increased post-weaning mortality.
2. Disturbance of lactating females resulting in a shift of breeding site in subsequent seasons (Condy 1977) and/or premature weaning of pups with resulting effects on pup survival.
3. Bulls charging through harems to confront human intruders resulting in trampling and possible death of pups (Carrick & Ingham 1962, Le Boeuf & Briggs 1977).
4. Mother-pup separation facilitated by increased bull or cow activity has previously been observed as a major cause of mortality among pups (Le Boeuf & Briggs 1977), as a result of starvation or injuries inflicted by other cows.

No large scale shift has occurred in the breeding population as indicated by the percentage of island pup production occurring in the disturbed area. If pups on disturbed beaches were more prone to post-weaning mortality one would expect a faster decline on these beaches due to the reduced recruitment to the breeding cow component as cows show birthsite fidelity for breeding (Nicholls 1970).

The effects relating to increased pre-weaning mortality are not supported by the results which show no difference between mortality in the two areas. This might be expected on Marion Island owing to the small size of most harems (mean harem structure – Beachmaster: Assistant beachmaster: Challenger : Batchelor: Cow = 1:0:0,5 ± 0,58:0,21 ± 0,69:22,57 ± 16,77). Increased bull activity in the harem would have less effect than in large densely packed aggregations of cows, where the bull would be much more likely to crush pups while moving through the harem. The consequences of cow-pup separation are also reduced since it is relatively easy for cows to locate their pups if separation occurs. This reduces both the chances of starvation and the frequency of attack by other cows while they are separated. The consequences of bull activity and cow-pup separation would be more serious in the much larger harems (mean harem structure on Kerguelen (Bester & Lenglart 1982) = 1:0,43:2,98:1,54:76,13 ± 111,55) found at the major breeding sites at Macquarie, Heard and Kerguelen Islands.

A 25-year period (1951 – 1976) before that considered in this study showed that pup production on Marion Island declined at 4,8 per cent per year. Research activities were limited to the final three summers of this period and thus the decline came about in the absence of onshore human influence. Between 1976 and 1986 the rate of decline decreased to 4,2 per cent per year despite the then increased levels of research activity on the island.

Table 4

Rates of decline in southern elephant seal populations of the Kerguelen and Macquarie stocks

Island	Rate of decline % per year	Period of decline	Source
Possession	5,8 %	1966-1976	Barrat & Mougin (1978)
Marion	4,6 %	1951-1986	Rand (1962), Present study
Kerguelen	4,1 %	1970-1977	Van Aarde (1980)
Heard	2,5 %	1949-1985	Burton (1986)
Macquarie	2,3 %	1959-1985	Hindell & Burton 1987

Comparison of rates of decline on different islands (Table 4) show no significant differences despite the differing levels of human activity on them. The Heard Island population was counted in 1985 for the first time since the ANARE base was abandoned in 1955. The numbers had declined by 60 per cent giving a yearly decline of 2,5 per cent. This compares with a decline of 2,3 per cent per year between 1959 and 1985 on Macquarie Island where a base has been maintained for the entire period and periodic counts of the seals have been made. Thus a population totally free of human influence declined at a greater, though not significantly so, rate than one where a human presence occurred.

It would, therefore, seem that research activities on Marion Island have not had a deleterious effect on the elephant seal population there. From comparisons between different sections of the island, and by whole island comparisons with other breeding sites, it would seem that onshore human disturbance is not a significant factor in the decline of the species.

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