Control of the Marion Island cat *(Felis catus)* population: Why and how

P.J.J. van Rensburg
Mammal Research Institute
University of Pretoria, Pretoria 0002

Present address:
Division of Nature Conservation
Private Bag X209, Pretoria 0002

The effect of the disease feline panleucopaenia (FPL) as a primary control measure for feral house cats (Felis catus) *on Marion Island (46°52'S, 37°51'E) is evaluated, suggesting a decrease in density, lowered fecundity and a change in the population age structure. At a low cat density FPL as a biological control measure is probably not effective. The smaller cat population is still reducing the burrowing petrels and this is reflected in a change in the diet of both cats and Antarctic skuas* (Catharacta antarctica) *and the higher breeding success of petrels in cat free areas. Hunting as a secondary control measure seems possible at a low density and a negative growth rate of cats. Female cats could be removed and density decreased linearly with time in an intensively hunted area, with hunting success and density showing no statistical relationship.*

Die uitwerking van die katsiekte panleukopenie (FPL) as 'n primêre beheermaatreël vir die wilde huiskatte (Felis catus) *op Marion-eiland (46°52'S, 37°51'E) word geëvalueer en dui op 'n afname in die diere se bevolkingsdigtheid en vrugbaarheid en op 'n verandering in die katbevolking se ouderdomstruktuur. FPL is by lae katdigtheid moontlik ondoeltreffend as 'n biologiese beheermaatreël. Die verkleinde katbevolking verminder nog steeds die grawende stormvoëls. Dit word deur 'n verandering in die dieet van katte sowel as bruin roofmeeue* (Catharacta antarctica) *weerspieël, asook deur 'n verbeterde broeisukses van stormvoëls in katvry gebiede. Wanneer die katte se bevolkingsdigtheid laag en hul aanteeltempo negatief is, kan daar as sekondêre beheermaatreël op die diere jag gemaak word. In gebiede waar intensief gejag word, kan die katbevolking reglynig met tyd verminder word en al die wyfies kan ook verwyder word. Daar is geen statistiese verwantskap tussen welslae met jag en die digtheid van die katbevolking gevind nie.*

Introduction

The growing feral cat population *(Felis catus)* on the sub-Antarctic Marion Island (46°52'S, 37°51'E) consumed already during 1975 about 450 000 burrowing petrels (Procellariidae and Pelecanoididae) and the disappearance of the common diving petrel *(Pelecanoides urinatrix)* as early as 1965/6 was ascribed to cat predation (Van Aarde 1980).

This depredation of the birdlife resulted in a decision preferably to exterminate the cats or at least to control their population growth. The latter could only be achieved if more than 20,8 per cent of the cats were removed annually. Any control method had to be target-specific with minimal disturbance to the environment (see Van Aarde 1984). Erasmus (1979) evaluated several control methods (i.e. trapping, poisoning and hunting) of which none was efficient. It was decided to use the feline panleucopaenia (FPL) virus as a biological agent since serological tests indicated that the 1975 cat population was fully susceptible to FPL. The virus is host-specific, highly contagious, resistant to environmental factors, produces high mortality in a susceptible population, involves an ever-increasing number of individuals and the disease is distributed world-wide (Van Aarde & Skinner 1981). Therefore the virus was introduced into the Marion Island cat population during March 1977 and its properties and epidemiology have been outlined by Howell (1984).

The present paper reports on preliminary and published results of the effects of the 1982 cat population on the birdlife and also the effects of FPL on the cat population, to illustrate why the control programme needs to be continued. Furthermore it illustrates the possible effectiveness of hunting as a secondary control measure.

The Marion Island cat population has a defined breeding season, a 1:1 sex ratio with nearly all adult females (one year +) being reproductively active and females producing a prenatal litter size of 4,6 twice a year (Van Rensburg *et al.* in press). These cats are nocturnally active with females being area-specific (Van Rensburg in prep.). In contrast, petrels are monogamous with a lifelong pair bond, lay one egg every second year, start to breed when five to six years old and lack an anti-mammalian predator strategy (Lack 1968, Van Aarde 1980).

Material and Methods

Material and information used in this study were collected during April 1981 to May 1983.

Population size was estimated by surveys of selected stratified grids (Van Aarde 1979). Population parameters of the cat population were analysed as described by Van Rensburg *et al.* (in press) and followed Caughley (1977) and Michod & Anderson (1980). Antibody titers of FPL were determined by the hemaglutinisation inhibition test (Johnson 1971).

Prey remains of cats and Antarctic skuas *(Catharacta antarctica)* were collected monthly in a specific study area and the stomach contents were collected from culled cats. These prey remains and stomach contents were analysed according to Van Rensburg (1985). Nest visits were monitored of great winged petrels *(Pterodroma macroptera)*, white chinned petrels *(Procellaria aequinoctialis)* and broad billed prions *(Pachyptila vittata salvini)* to determine their breeding success in three cat free and control areas (see Van Rensburg & Bester in press a).

Night hunting expeditions were conducted intensively in two areas in an opportunistic way by two persons, using a 12 bore shotgun and a spotlight (see Van Rensburg & Bester in press b).

Results and Discussion

The primary control method (FPL) was evaluated by comparing the population characteristics of the 1982 cat population, five years after the introduction of FPL, with those of the 1975 population. Since the introduction of FPL during 1977, the cat population decreased by 29,0 per cent per annum to 615 ± 107 cats in 1982. Post-weaning litter size decreased significantly from 2,7 in 1975 to 1,7 in 1982 (t_{70} = 5,80; P< 0,05) which resulted in a significant change in the age structure (Table 1),

Table 1

Age structure of the 1975 and 1982 cat population of Marion Island (Van Rensburg *et al.* in press)

	1975	1982
Subadults (<1 yr)	40,8%	28,0%
Adults (>1 yr)	59,2%	72,0%
n	169	118

x_1^2 = 5,02; P<0,05

due to a decrease in subadult numbers (Van Rensburg *et al.* in press). The decrease of subadults accords with the epidemiology of FPL where kittens which loose their maternally derived immunity become susceptible to the disease after weaning and mortality occurs mainly amongst cats <1 yr (Fastier 1968, Scott *et al.* 1970, Reif 1976). Antibody titers for FPL changed significantly from 1978 to 1982 with a decrease in the frequency of occurrence of higher antibody titers (Table 2).

Table 2

The occurrence (%) of FPL Antibody titres of the cat population on Marion Island (Van Rensburg *et al.* in press)

	Antibody titres									
	0	16	32	64	128	256	512	1024	2048	4096
1978 (n=57)	21,0	0	1,8	12,3	15,8	15,8	17,5	8,8	3,5	3,5
1982 (n=115)	16,5	4,3	19,1	20,0	14,8	11,3	13,0	0,9	0	0

x_8^2 = 28,53; P<0,05

This illustrates that FPL did affect the cat population, but that it does not spread effectively anymore. Furthermore, the cat population decreased by 8,0 per cent from 1981/82 to 1982/83. This decrease was, however, not significant (t = 1,47) and suggests that the negative growth rate may be stabilising. Since fecundity of one-year-old females was higher during 1982 (F_1 = 1,54) than before the introduction of FPL (F_1 = 0,67), this resulted in a higher intrinsic rate of increase of r = 1,61 compared to r = 1,17 during 1975 (Van Rensburg *et al.* in press). FPL was therefore successful as a primary control measure in lowering the density of cats drastically. However, at a low density FPL is possibly inefficient for controlling a cat population which has a high reproductive potential for increase.

How does the lowered cat density affect the bird population? Petrels decreased and mice increased significantly in the stomach contents of cats from 1975 to 1982 in both the number of stomachs and the number of prey items (Table 3). Kerguelen petrels *(Pterodroma brevirostris)* decreased significantly in the prey remains of cats between 1975 and 1982 (x^2 = 5,28; P<0,05), where larger-sized petrels (white chinned - and great winged petrels) (x^2 = 23,81 and 6,55; P<0,05 respectively) increased and medium sized petrels (Kerguelen and soft plumaged petrels *Pterodroma mollis)* decreased (x^2 =

Table 3

The occurrence of prey items in the stomach contents of cats on Marion Island (Van Rensburg 1985)

	Stomachs (%)				Prey items (%)			
	1975	1982	x^2	P	1975	1982	x^2	P
Mice	16,4	41,3	18,84	<0,05	16,9	48,0	24,79	<0,05
Petrels	97,4	83,9	13,82	<0,05	77,5	49,1	15,10	<0,05
n	116	143			160	271		

20,00 and 9,61; P<0,05 respectively) in the prey remains of Antarctic skuas *Catharacta antarctica*. The number of prey remains collected over the same period in a specific study area during 1975 and 1982 decreased from 709 to 125 and 447 to 207 for cats and skuas respectively (Van Rensburg 1985). These changes in diet reflect changes in the relative abundance of petrels with skuas probably now preying more intensely on penguins. Breeding success of great winged petrels, white chinned petrels and prions was significantly higher in all the cat free areas combined (Table 4). Great winged petrels were affected seriously by cat predation where breeding success was 2,4 per cent (n = 42) and 51,3 per cent (n = 39) in the control and cat free areas respectively (Van Rensburg & Bester in press a).

Table 4

Breeding success (%) of three Procellariidae species during 1982/3 on Marion Island (Van Rensburg & Bester in press)

	Cat free	n	Control	n	x^2	P
Pterodroma macroptera	51,3	39	2,4	42	25,18	<0,05
Procellaria aequinoctialis	85,7	28	55,6	27	6,06	<0,05
Pachyptila vittata	66,7	84	50	60	4,04	<0,05

The feeding and population parameters illustrate that the cats are still reducing the numbers of burrowing petrels and that the cat population is probably recovering from the onslaught of the primary control measure. Furthermore with an r-selected predator and a K-selected prey, a recovery of the prey population and the maintenance of a predator-prey balance are most unlikely. Further control of the cat population is therefore essential. This resulted in an experimental hunting effort to examine the feasibility of hunting as a secondary control measure.

A population can be permanently reduced by preventing it from breeding. Since female cats on Marion Island are area-specific it was possible to eliminate females in a hunting area where the sex ratio changed to favour males during the course of four months of hunting (Fig. 1). Hunting success (expressed as the percentage cats killed of the number of cats sighted) and density (number of cats sighted per hour) showed no relationship (r_5 = 0,177; n = 104: Van Rensburg & Bester in press b). Density also decreased linearly with time in another hunting area which was hunted intensively over a relatively short period (7 expeditions over 22 days) (Fig. 2).

Such a sudden reduction in density may be disrupting the social system of cats by creating a vacuum and promoting movement which could result in FPL still operating actively as a biological control measure at a low cat density. As hunting proved feasible in all areas of the island, an intensive and constant hunting effort by a sufficient number of hunting teams operating simultaneously round the island are necessary for an effective secondary control effort. This would be most cost-effective during the breeding season of the cats. Such a control

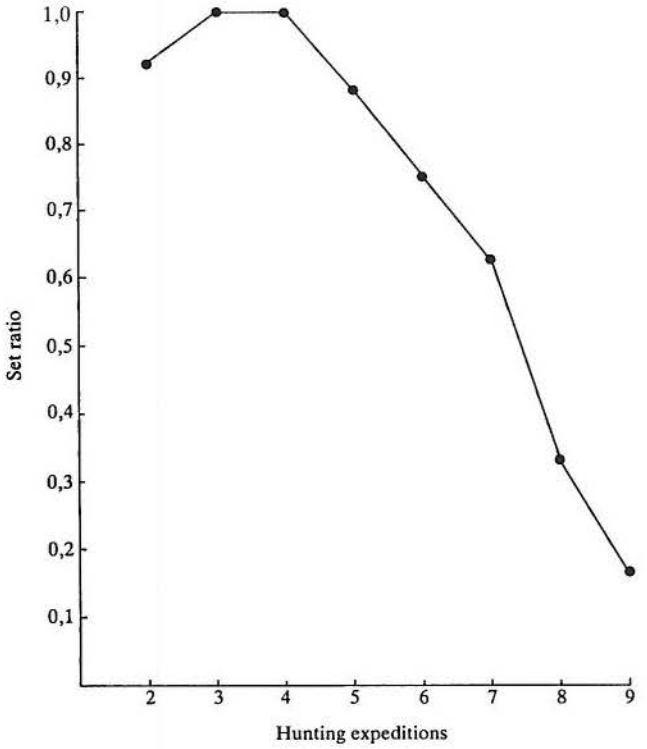

Fig. 1. Weighted mean $(\frac{x_{n-1} + 2x_n + x_{n+1}}{4})$ sex ratio (♀/♀ + ♂) of cats culled (n=19) in hunting area A on Marion Island during January to May 1982 (Van Rensburg & Bester in press b).

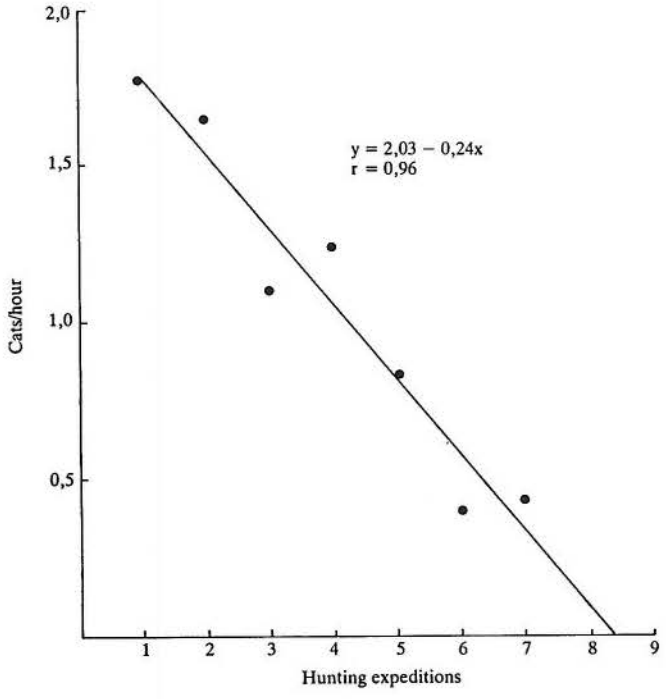

Fig. 2. Cat sightings per hour (density index) for hunting expedition conducted in hunting area B on Marion Island during May 1982 (Van Rensburg & Bester in press b).

effort should be repeated during the following breeding seasons to ensure the elimination of all females. Since hunting was impractical at a relatively high density and a positive growth rate, the further control of this population should be implemented as soon as possible before such a situation arises again.

Acknowledgements

Financial and logistical support were provided by the South African Department of Transport on advice of the South African Scientific Committee for Antarctic Research. I wish to thank Prof J.D. Skinner, Director of the Mammal Research Institute, and Drs M.N. Bester and R.J. van Aarde for their encouragement and advice.

References

CAUGHLEY, G. 1977. Analysis of vertebrate populations. Wiley and Sons, New York.

ERASMUS, B.H. 1979. Control of the feral cat *Felis catus* (Linnaeus, 1758) population on Marion Island with feline panleucopaenia. M.Sc. thesis, Univ. of Pretoria, Pretoria. 115 pp.

FASTIER, L.B. 1968. Feline panleucopaenia. A serological study *Vet. Rec.* 83: 653 - 655.

HOWELL, P.G. 1984. An evaluation of the biological control of feral cat *Felis catus* (Linnaeus, 1758). *Acta Zool. Fenn.* 172: 111 - 113.

JOHNSON, R.H. 1971. Serologic procedures for the study of feline panleucopaenia. *J. Am. vet. med. Assoc.* 158: 876 - 884.

LACK, D. 1968. Ecological adaptations for breeding in birds. Methuen, London.

MICHOD, R.E. & ANDERSON, W.A. 1980. On calculating demographic parameters from age frequency data. *Ecology* 61: 265 - 269.

REIF, J.S. 1976. Seasonality, natality and herd immunity in feline panleucopaenia. *Am. J. Epidem.* 103: 81 - 87.

SCOTT, F.W., SCIZA, C.R. & GILLESPIE, J.H. 1970. Maternally derived immunity to feline panleucopaenia. *J. Am. vet. med. Assoc.* 156: 439 - 453.

VAN AARDE, R.J. 1979. Distribution and density of the feral house cat, *Felis catus* on Marion Island. *S. Afr. J. Antarct. Res.* 9: 14 - 19.

VAN AARDE, R.J. 1980. The diet and feeding behaviour of feral cats, *Felis catus* at Marion Island. *S. Afr. J. Wildl. Res.* 10: 123 - 128.

VAN AARDE, R.J. 1984. Population biology and the control of feral cats on Marion Island. *Acta Zool. Fenn.* 172: 107 - 110.

VAN AARDE, R.J. & SKINNER, J.D. 1981. The feral cat population at Marion Island Characteristics, colonization and control. C.N.F.R.A. 51: 281 - 288.

VAN RENSBURG, P.J.J. 1985. The feeding ecology of a decreasing feral house cat, *Felis catus,* population at Marion Island. In: Antarctic Nutrient Cycles and Food Webs. Proceedings of the fourth SCAR Symposium on Antarctic Biology. Eds W.R. Siegfried, P.R. Condy and R.M. Laws. Springer-Verlag, Berlin, pp. 620 - 624.

VAN RENSBURG, P.J.J. & BESTER, M.N. in press a. The effect of an elimination of cat *Felis catus* predation on three breeding Procellariidae species on Marion Island. *S. Afr. J. Zool.*

VAN RENSBURG, P.J.J. & BESTER, M.N. in press b. The effect of an experimental hunting effort on the feral house cat population of Marion Island. *S. Afr. J. Wildl. Res.*

VAN RENSBURG, P.J.J., SKINNER, J.D. & VAN AARDE, R.J. in press. Effects of feline panleucopaenia on the population characteristics of feral cats on Marion Island. *J. Appl. Ecol.*