OBSERVATIONS ON A POPULATION OF SPRINGBOK *ANTIDORCAS MARSUPIALIS* PRIOR TO AND DURING A SEVERE DROUGHT

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SUMMARY

The changes in a population of springbok confined to a paddock on a farm in the Karoo were observed for 12 years. The observations and data on the age structure, obtained from skulls in the paddock, were used to construct a model of the population changes over the first 10 years. In the 11th year the population was severely depleted as a result of drought. Possible reasons for the magnitude of the population decrease are discussed in relation to the model and the losses in other paddocks on the same farm.

INTRODUCTION

In the past the nomadic habits of springbok *Antidorcas marsupialis* in the Karoo probably limited the over-utilisation of the food resources in a particular region and it has been suggested that the reproductive rate is a function of environmental conditions (Skinner, Van Aarde & Van Jaarsveld 1984). This would tend to reduce the depletion of the food resources over their entire range. Now that movement is restricted and natural predators excluded by the presence of fences, management is required to supplement any natural regulation of the reproductive rate to prevent the over-utilisation of the vegetation.

This paper describes the growth of a springbok population confined in an experimental paddock for a period of 12 years which culminated in a severe drought.

MATERIAL AND METHODS

The study was carried out on the farm Biesjiesfontein (31°30′S and 23°15′W, mean elevation 1 280 m) near Victoria West in the Central Upper Karoo (veld type number 27, Acocks 1953). The experimental paddock was located on a floodplain. Further details are provided by Davies, Botha & Skinner (1986).

In 1973, seven springbok were confined in a paddock (190 ha) surrounded by a 1,1 m fence, no other livestock being present. The paddock was surrounded by other paddocks belonging to the same farm and springbok on this farm have never been known to cross a fence of this type. During the ensuing 12 years no animals were removed from the paddock, no supplementary food was provided and no dressing or water was applied to the land.

A count was made in 1976 and a census taken in April 1983, 1984 and 1985 (Davies 1985). During 1983–1984 all the skulls in the paddock were collected (129), the sex determined and age of the animal at the time of death estimated using the criteria set by Rautenbach (1971). Incidental observations of the age structure of subpopulations from other camps were included.

Climatological data were obtained from the Directorate of Weather Bureau and were supplied by the station at Beaufort West.

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RESULTS

In April 1983 the population had increased to 130 which implies an exponential rate of increase of 29,2 % p.a. (Caughley 1977). However it is unlikely that an exponential curve can be used to describe the growth of this population because, on that basis, the population in 1976 would have been 17 whereas 53 were observed (Fig. 1). With only three observations between 1973 & 1983 it is not possible to fit any asymptotic regression curve but two other figures can be calculated based on the increase from seven to 53 in three years. Because of the physiological limitations of the female reproductive system (1 young/parturition, a gestation length of 6 months, a lactation anoestrus of 3 months, age at maturity 5–6 months, Skinner, von La Chevallerie & Van Zyl 1971) the population must have bred maximally in 1974 & 1975. Furthermore only one male would have been included in the original group of seven.

The logistic curve illustrated in Fig. 2 is obtained if an asymptote of 134 is selected, the calculated points from this are similar to the observations at the same point on the curve. Curves obtained with higher asymptotes are also significant but the agreement with observations are poorer. The minimum asymptote is dictated by the highest observations. The survival curve was obtained by fitting an asymptotic regression (Stevens 1951) to the age structure of the population obtained from the skulls (Fig. 3). Fifty-two carcasses of springbok, which had died a 'natural death', recovered from other camps on the same farm had an age structure which did not differ significantly from that predicted from the survival curve ($\chi^2 = 5.42$ 4DF n.s.).

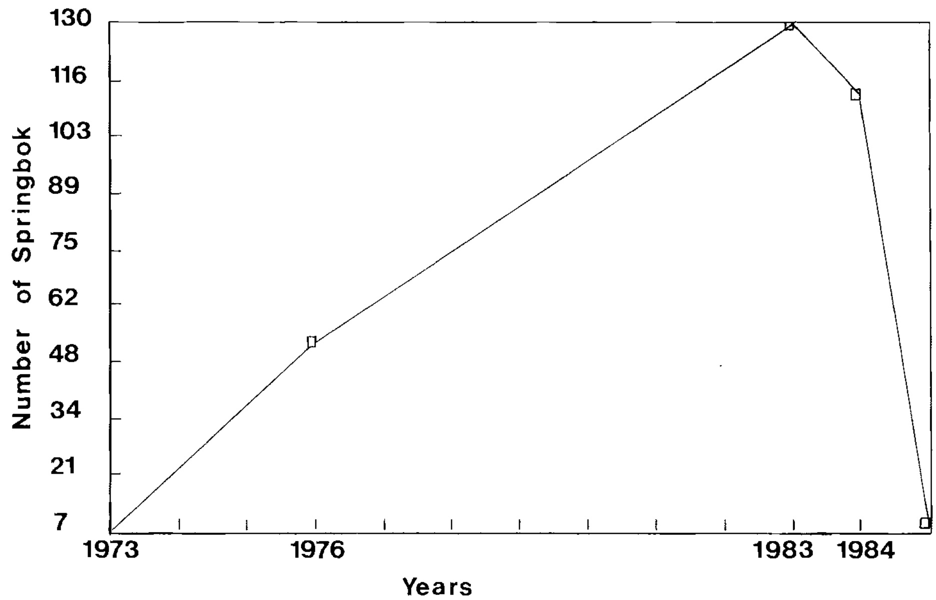

Fig. 1 The number of springbok known to be in the camp between 1973 & 1985.

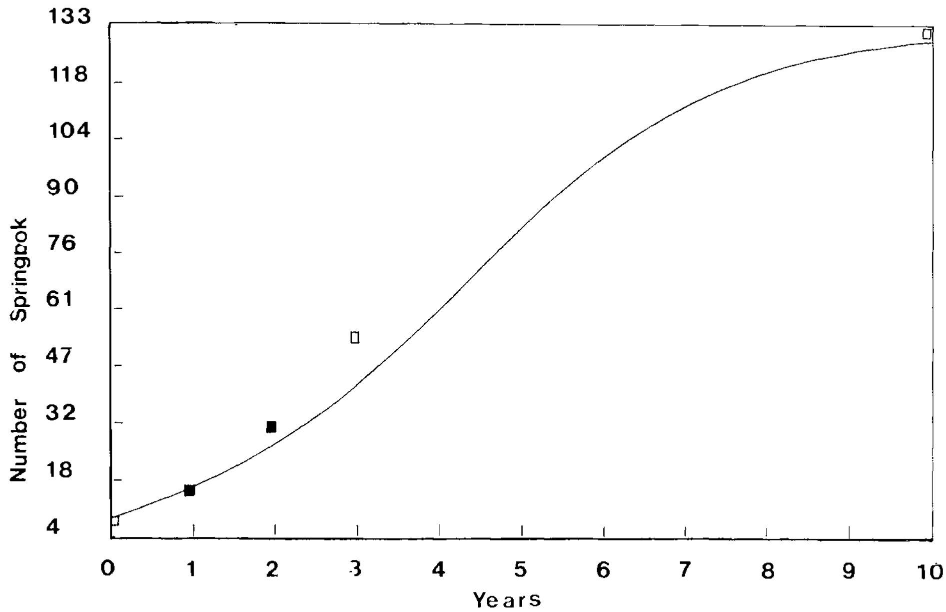

Fig. 2 Plot of the number of springbok (N) vs years (T). The curve was calculated from $N = K/(1 + e^{A+RT})$. An asymptote of 134 was used. $A = 2.647 \pm 0.292$ $R = -0.625 \pm 0.004$ $t = -17.562$ 3DF $P < 0.001$ Corr. coeff. -0.995

□ Data points ■ Calculated points

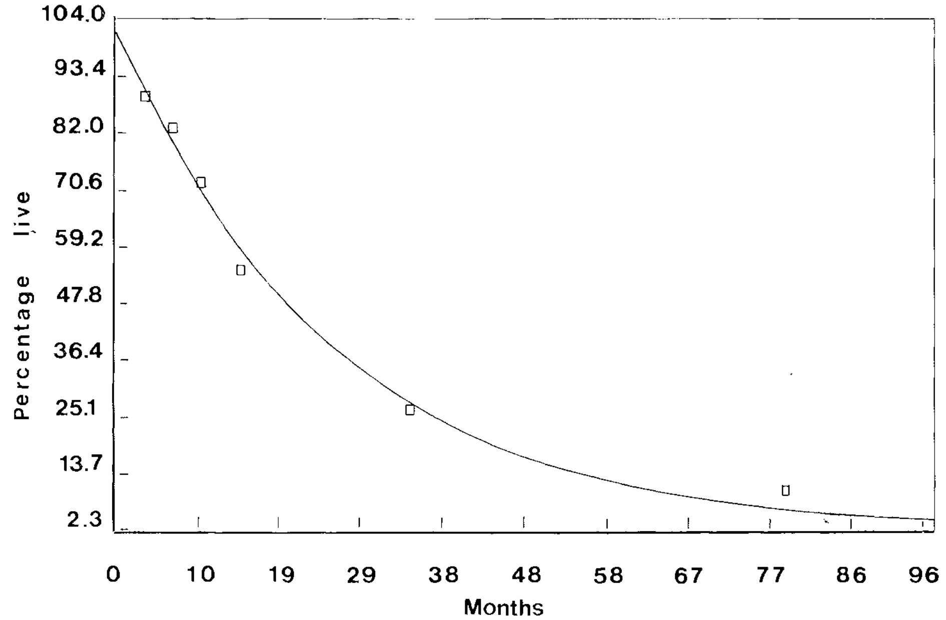

Fig. 3. Plot of % of animals alive (Y) vs age (months X)
The curve was calculated from $Y = A + BR^x$
A(asymptote) $= 1.87 \pm 0.94$ B(range) $= 100.89 \pm 1.03$ R(rate of decrease) $= 0.961 \pm 0.001$
$t = 42.224$ 5DF $P < .001$ Corr coeff 0.999
□ Data points

The growth curve and the survival curve were used to calculate the age structure of the population from 1973–1983 (Table 1). The final sex ratio (Table 2) is close to that observed and the age structure of the population in 1983 agrees with the results obtained from the census in 1983 (Fig. 4 ca. 37 % 1 year old or less in both).

In April 1984 the population had declined by 17 to 113 and the sex ratio had changed from 1,3:1 to 1,7:1 suggesting that more males than females had died and that the population had reached the asymptote. In April 1985 only 8 females (one of which had a lamb) were found and no males.

The mean annual rainfall and the mean maximum and minimum temperatures during August for the period 1973–1984 are shown in Fig. 5 & 6.

Table 1

Age structure 1973–1983 calculated from the growth curve (Fig. 2) and survival curve (Fig. 3).

1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
8.87										
7.65	8.02									
6.32	6.62	13.63								
4.75	4.97	10.2	22.45							
3.43	3.57	7.29	16.01	31.8						
2.34	2.39	4.82	10.51	20.76	41.92					
1.6	1.59	3.14	6.73	13.17	26.43	47.96				
1.14	1.09	2.09	4.38	8.44	16.77	30.24	49.64			
0.86	0.78	1.43	2.91	5.49	10.75	19.19	31.3	49.66		
0	0.58	1.02	2.0	3.65	6.99	12.3	19.87	31.31	49.79	
0	0	0.77	1.43	2.5	4.65	8.0	12.73	19.87	31.4	49.1

Underlined figures are the number recruited in the year at the head of the column.

Figures on rows are the number born in the year at the head of the column that were still alive in the year indicated by the column with underlined figures on the same row, e.g. 2 born in 1976 were still alive in 1982; 8 born in 1979 were alive in 1983.

Table 2

Calculated population growth, number of young/female and sex ratio from 1973–1983

Year	Pop. Size	No./fem.	Fem/mal*	Year	Pop. Size	No./fem.	Fem/mal
1973	8.87		3.74	1979	100.62	1.19	1.36
1974	15.67	1.22	2.91	1980	113.79	1.04	1.33
1975	26.58	1.26	2.69	1981	122.37	0.93	1.32
1976	42.36	1.31	2.13	1982	127.51	0.88	1.31
1977	62.1	1.27	1.7	1983	130.45	0.83	
1978	82.73	1.28	1.45				

Mean no. of young/female/year = 1.12 ± 0.185(s.d.)

Proportion of non-breeding females
1982 0.07
1983 0.12

* The sex ratio was initially set to the value observed in 1983, if the number of females was too low to produce the number of recruits required in a particular year the sex ratio was altered in favour of females.

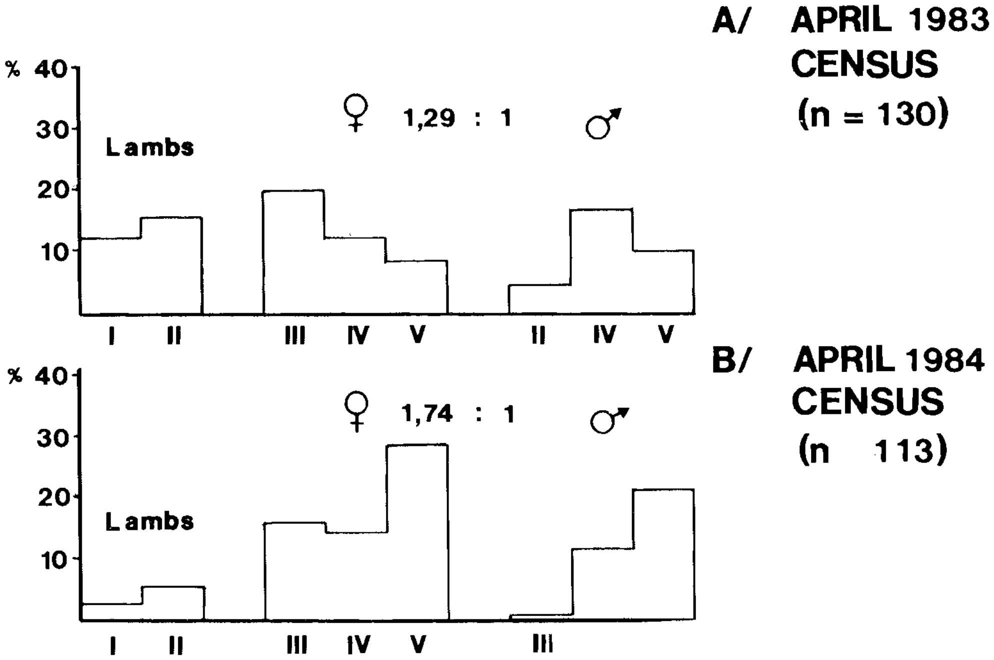

Fig. 4. Histogram of the results of the census in 1983 & 1984.
The roman numerals are the age classes as described by Rautenbach (1971) modified by Liversidge (pers. comm.)

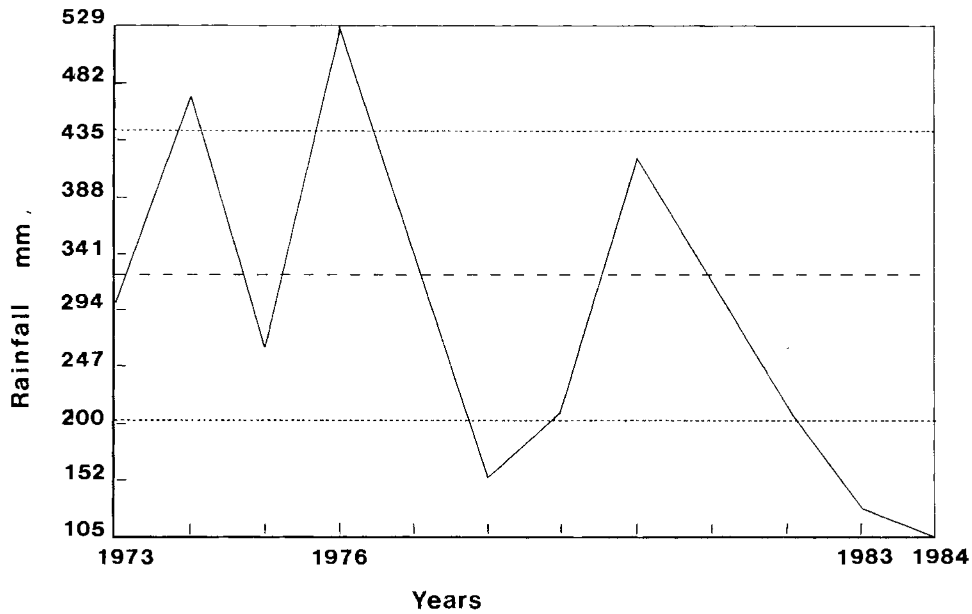

Fig. 5. Rainfall as reported from Beaufort-West weather station 1973–1984
-------- Mean of years 1973–1982
.... ± 1 Standard deviation

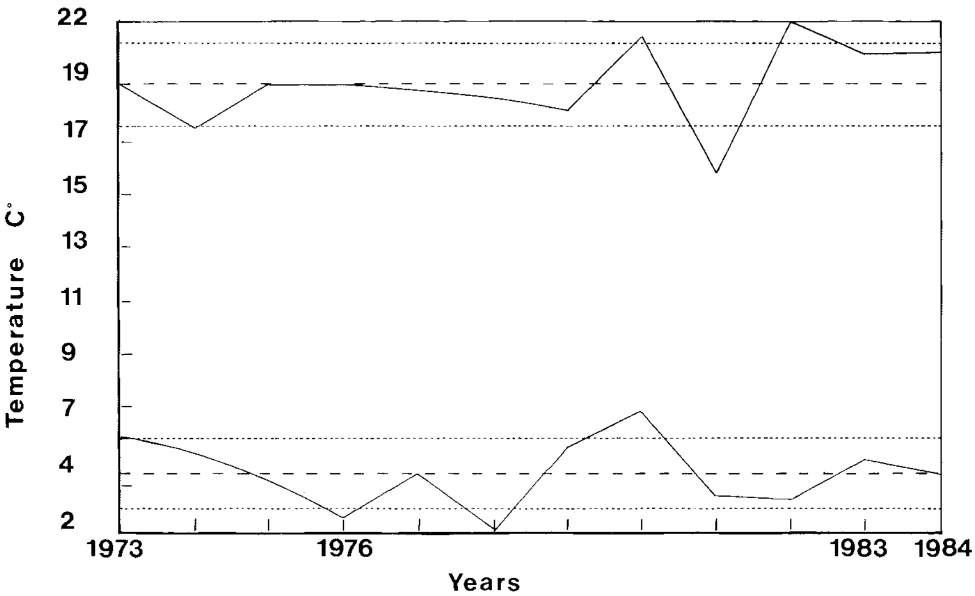

Fig. 6. Mean maximum & minimum temperatures in August for the years 1973–1984 (from Beaufort West)
-------- Mean for 1973–1984
.... ± 1 Standard deviation

DISCUSSION

The age structure and growth of this isolated population of springbok appears to be represented closely by the logistic curve for population growth and the asymptotic regression for survival, both in terms of statistical precision and from the prediction of values not included in the calculation. An asymptotic regression curve could have been used for the population growth but when very slight alterations were made to the data the iteration did not converge and the calculated asymptote was unreasonably high (340) for the conditions. The form of Table 1 and the deductions made from it were not affected by the growth curve used in its construction.

The agreement between the theoretical population structure and the observed values for sex ratio and age structure in 1983 lend support to the deduced value for the proportion of non-breeding ewes (Table 2) for which there is no direct supporting data. From 1982 onwards an increasing proportion of ewes did not breed. The decline in the population (by 17) in 1984 suggests that only 32 animals were recruited (ca 49 appear to be required to maintain a population of 120–130, Table 1). The figure of 32 is a lower estimate because the number dying may have been greater than in preceding years.

The decrease in the proportion of breeding females may have been an indication that the population was vulnerable to an additional stress, an indication that was reinforced by the decline in numbers in 1984.

Both factors are particularly significant when considered in relation to the growth in the population of springbok in other camps on the same farm in this period (Davies 1985).

The springbok population in all camps on the farm suffered severe losses between July & September 1984, the mean loss in all camps being ca 60 %, ranging from 0–92 % (Davies 1985). The most severe loss occurred in the camp we have described above. There seems little doubt that the ultimate cause of the population crash was the effect of the severe drought on the vegetation. The drought was common to all camps but the vegetation in this camp was different from the neighbouring camp although they were similar when the boundary fence was erected in 1973. In 1984 the canopy cover was lower (28.7 % vs 43.5 %), there was a paucity of 'less palatable Karoo shrubs', particularly preferred by springbok (Davies, Botha & Skinner 1986) and a preponderance of lignified grass in the camp under consideration (Davies 1985) even though the springbok biomass was similar in the two camps (14.7 kg/ha vs 13.7 kg/ha) and the neighbouring camp also carried an extra biomass of Merino sheep (7.32 kg/ha). In a study involving all the camps on the farm Davies (1985) found no correlation between combined springbok and sheep biomass and the proportion of springbok lost during the crash.

An experiment is under way to examine the effects of mixed groups of springbok and Merino sheep on the vegetation on different qualities of veld, to determine the most productive combination and to monitor factors which might be used to assess the vulnerability of a population of springbok to additional stress.

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