Influence of a nutritional parameter on the size differences of the three springbok subspecies

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Apparent size differences in the three subspecies of the springbok *Antidorcas marsupialis* were compared in relation to the mean dietary protein values analysed from rumen contents of test animals. Body mass was highly correlated with the winter dietary protein in both sexes. No significant differences were found to exist between the mean body mass values of the two northern subspecies. Significant differences did however exist between the nominate subspecies and the two northern taxa. Similar tendencies were illustrated for most comparisons of subspecific dietary protein values.
S. Afr. J. Zool. 14: 13–15 (1979)

Waarneembare verskille in grootte van die drie subspesies van die springbok *Antidorcas marsupialis* is vergelyk met betrekking tot die gemiddelde proteïenwaarde in die dieet soos verkry deur analise van die rumeninhoud van eksperimentele diere. Daar was by beide geslagte 'n opvallende korrelasie tussen liggaamsmassa en die winterproteïendieet. Geen betekenisvolle verskille is gevind tussen die gemiddelde liggaammassas van die twee noordelike subspesies nie. Daar is egter betekenisvolle verskille gevind tussen benoemde subspesies en die twee noordelike taksa. Soortgelyke tendense is ook waargeneem met betrekking tot die meeste ander parameters wat vergelyk is met die proteïnwaardes in die dieet van hierdie subspesies.
S.-Afr. Tydskr. Dierk. 14: 13–15 (1979)

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Accepted 1 August 1978

Currently three subspecies of the springbok *Antidorcas marsupialis* are recognized, the distribution limits of which have never been satisfactorily defined. The range of the nominate, *A. m. marsupialis*, is thought to extend throughout South Africa, while *A. m. hofmeyri* is reported to inhabit the southern region of South West Africa and Botswana. The most northern subspecies *A. m. angolensis* is restricted to northern South West Africa and Angola (Ansell 1971).

The separation of the species into different taxa has largely depended on minor phenotypic differences often based on inadequate material (Lydekker & Blaine 1914, Blaine 1922, Thomas 1926). However, as reported by Roberts (1951) and confirmed in the present study, the animals from South West Africa are larger than those from South Africa. Differences in body mass and other size parameters largely coincide with the subspecific geographic separation of the species as defined by Ansell (1971).

The aim of the present paper was to ascertain whether a nutritional component as suggested by crude rumen protein levels may contribute to the subspecific mass differences.

Material and Methods

Rumen samples

Grab samples comprising approximately 70 per cent by mass of the total rumen contents were collected from 74 mature animals at 10 localities (Robinson & Skinner 1976). Samples were collected in the winter months of two consecutive years. The samples were sun-dried and stored in sealed plastic bags for later analysis.

Composite samples for specific localities were created by thoroughly mixing the representative stomach contents, and a random sample of 500 g was selected for each locality. These subsamples were then analysed for crude protein using standard techniques, resulting in a mean value for each locality.

Calculations

To establish whether a mass parameter could be considered indicative of body size in the species, correlation coefficients for the ratios between body mass and total length (excluding tail length), shoulder height and chest girth respectively were calculated for 91 animals at 12 localities. This sample size includes animals from two localities for which protein values were not available (Tsumis Park and Karasburg in South West Africa). In addition, use was made of the volume index, i.e. chest girth^2 × total length (McCulloch & Talbot 1965), which was then correlated to mass in order to establish whether an improved relationship for this parameter resulted. Only mature animals (Rautenbach's age class V and above) were used in the computation of the correlation coefficients (Rautenbach 1971).

To examine the relationship between mass and differing protein values, correlation coefficients using the mean protein value of each locality *vs* the mean body mass data of the corresponding locality were computed separately for each sex. Although not statistically desirable, the use of mean values in the calculation of these correlation coefficients was dictated by the fact that the protein values were established from pooled samples.

Tests of significance between subspecific protein values and body masses were made using the t test for two unknown means (μ_1 and μ_2) with unknown variance (σ^2).

Results

The mean protein values for composite samples from different localities are presented in Table 1. Comparisons of these values at subspecies level using the t test are given in Table 2(a).

Correlation coefficients (r) calculated to ascertain whether body mass could be considered a valid criterion of the size of an animal are given in Table 3. The four parameters used were shown to be highly correlated with body mass ($P < 0{,}01$), and consequently seem to justify the use of this character as an indicator of overall size of the springbok. A substantially improved correlation was obtained using the volume index : body mass ratio.

Correlation coefficients calculated from the mean protein values and the corresponding body mass values for each locality were 0,75 and 0,63 for rams and ewes respectively. Both values were significant at the 95 per cent level. The t values for each sex, which are given in Table 2(b), result from comparisons of mean body mass differences between subspecies (Table 4).

Discussion and Conclusions

Although each locality was sampled only once, resulting in inadequate sample sizes and seasonal representation, certain tendencies were apparent. The crude protein percentages established from the rumen contents of test animals are significantly correlated with body mass and hence with the size of the animals.

The slightly lower correlation coefficients illustrated for ewes (Table 3) may be due to discrepancies in body mass caused by the inclusion of pregnant ewes in the study material. Of the 40 ewes used for these calculations, 16 contained foetuses at various stages of development. Since body mass included the mass of the gravid uterus, mass measurements of those females might be exaggerated. Should this assumption be valid, underestimation of mass differences between the nominate and the other subspecies would have occurred, since 14 of the 16 pregnant ewes were in the sample of *A. m. marsupialis*. It is also possible that foetal mass may be responsible for the lower correlations of body mass with protein for ewes.

To substantiate the argument that the apparent mass differences between taxa may be attributable to a nutritional

Table 1 Mean crude rumen protein and body mass values of springbok from 10 localities

Locality	Month	Rumen protein[a]	Sex	Body mass[b] (kg)	n	Subspecific range
Furnas, Angola	Jul 73	14,3	Male	38,2 ± 4,51	3	*A. m. angolensis*
			Female	31,2 ± 1,06	2	
Kaokoveld, SWA	Jul 73	15,7	Male	42,3 ± 4,98	7	
			Female	32,3 ± 1,89	3	
Stampriet, SWA	Jul 73	15,8	Male	36,4 ± 1,70	4	*A. m. hofmeyri*
			Female	30,2 ± 0,35	2	
Kalahari Gemsbok National Park	Apr 74	16,2	Male	45,8 ± 2,41	5	
			Female	37,4 ± 1,14	5	
Hutchinson	Aug 73	12,6	Male	30,6 ± 3,90	4	*A. m. marsupialis*
			Female	25,0 ± 1,50	3	
Cradock	Sep 74	15,1	Male	34,3 ± 5,63	4	
			Female	26,8 ± 1,88	4	
Edenville	Sep 74	11,3	Male	32,7	1	
			Female	28,3 ± 1,81	3	
Kroonstad	Jul 73	13,7	Male	28,2 ± 1,06	2	
			Female	25,1 ± 1,99	6	
S.A. Lombard Nature Reserve	Aug 74	12,6	Male	30,8 ± 2,04	5	
			Female	28,8 ± 0,63	4	
Ermelo	May 74	13,3	Male	30,6 ± 1,79	5	
			Female	25,3 ± 2,40	2	

[a] Mean value for each locality.

[b] Mean ± S.D.

Table 2 (a) Mean protein level of rumen contents and (b) body mass in the three subspecies of springbok

Subspecies compared	t value	d.f.
(a) Mean rumen protein		
A. m. angolensis : A. m. hofmeyri	−1,37	2
A. m. angolensis : A. m. marsupialis	1,89 (2,96*)	6
A. m. hofmeyri : A. m. marsupialis	3,03* (4,77*)	6
(b) Body mass		
Rams		
A. m. angolensis : A. m. hofmeyri	−0,24	17
A. m. angolensis : A. m. marsupialis	6,41*	29
A. m. hofmeyri : A. m. marsupialis	6,39*	28
Ewes		
A. m. angolensis : A. m. hofmeyri	−2,0	10
A. m. angolensis : A. m. marsupialis	5,15*	25
A. m. hofmeyri : A. m. marsupialis	7,89*	27

* P < 0,05. Values in parentheses exclude data from Cradock.

component as suggested by the rumen protein levels, statistical comparisons of the subspecific mass and protein means were conducted (Table 2).

Mean body mass differences between the two northern subspecies *A. m. angolensis* and *A. m. hofmeyri* were not significant for both sexes. Mass differences between the nominate subspecies and *A. m. angolensis* and *A. m. hofmeyri* respectively proved to be significant (P < 0,05) for both sexes. It may be concluded therefore that although the two northern subspecies do not differ significantly in mass, both taxa differ significantly from *A. m. marsupialis*.

Similarly, t values resulting from a test between the dietary protein values of *A. m. angolensis* and *A. m. hofmeyri* were not significantly different. Significant results were obtained when *A. m. hofmeyri* was tested against *A. m. marsupialis*. However, a test between the dietary protein values of *A. m. angolensis* and *A. m. marsupialis* was not significant at the 95 per cent level.

Recomputation of the latter combination, excluding the protein value of 15,1 from the Cradock sample which appears atypical for the nominate subspecies, resulted in a significant t value. The reason for the high protein value from this (southern) area cannot be satisfactorily explained. From these results it would appear that as with the body mass comparisons, no significant differences exist between the winter protein values of the two northern subspecies. Furthermore, although a significant difference exists between *A. m. hofmeyri* and the nominate subspecies, the significance of the comparison between *A. m. angolensis* and *A. m. marsupialis* was marred by the unexpectedly high protein value found in the Cradock sample.

Larger samples, more adequate seasonal representation and controlled experiments using different protein regimes are essential to fully substantiate the indications resulting from this study. Furthermore, in addition to the strong evidence that winter rumen protein levels are largely responsible for subspecific size differences, other important environmental factors may be involved, but they may be masked by the protein effect.

Table 3 Correlation coefficients (r) for the relationships between mass and other body parameters

Relationship between body mass and:	Sex	d.f.	Correlation coefficients
Total length	Male	49	0,88*
	Female	38	0,83*
Body height	Male	49	0,76*
	Female	38	0,72*
Chest girth	Male	49	0,87*
	Female	38	0,80*
Volume index[a]	Male	49	0,92*
	Female	38	0,88*

*P < 0,01

[a] Chest girth^2 × total length

Table 4 Body mass (mean ± S.D.) in the three subspecies of springbok

Sex	*Subspecies*	Body mass (kg)	n
Male	*A. m. angolensis*	42,0 ± 5,00	10
	A. m. hofmeyri	41,6 ± 5,35	9
	A. m. marsupialis	31,2 ± 3,43	21
Female	*A. m. angolensis*	31,9 ± 1,56	5
	A. m. hofmeyri	35,4 ± 3,69	7
	A. m. marsupialis	26,5 ± 2,20	22

Acknowledgements

My thanks to Professors J.D. Skinner and J.M.P. Geerthsen for their advice and to Dr N. Fairall for reviewing the manuscript. A grant from the CSIR is gratefully acknowledged.

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