THE QUALITY OF DIET SELECTED BY ELAND IN NORTHERN NAMIBIA: CRUDE PROTEIN, CRUDE FIBRE, FAT AND ADF CONTENTS

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ABSTRACT

The quality of diet of the free-ranging eland (*Taurotragus oryx*) was determined in a series of trials over a three-year period from May 1991 until April 1994. This project was carried out in northern Namibia, making use of esophageally fistulated animals and creating a near-to-natural situation. The study was undertaken to assess the quality of diet that eland were selecting, in terms of fibre, protein, fat and ADF contents, taking into consideration that the botanical composition, calcium and phosphorus concentrations in the diet had also been assessed. The study field was in the semi-arid part of southern Africa, where vegetation cover is low, rain is erratic, but woody species tend to encroach. Research data showed that eland choose their diet very selectively and that the quality of the diet, utilising browse most of the year, tends to be extremely good. The percentage of protein in the diet varied from 8,3 to 25,12% during the three-year period under review, that of fibre from 19,55 to 39,00%, that of fat from 1,32 to 3,77%, and that of ADF from 32,83 to 62,49% over the same period. These values were compared with other studies of wildlife in southern Africa and compared well.

INTRODUCTION

Little is known about the quality of diets of free-ranging wild ungulates in Namibia. The fact is that researchers have done research on livestock such as cattle, sheep and goats, but very little research has been done on one of the most important assets of the agricultural setup in Namibia, i.e. wildlife.

Many ranchers are feeding wild animals in times of drought, without knowing the requirements of the animals for maintenance or reproduction. It then happens that animals die because they have been fed only the ration ordinarily given to cattle for maintenance purposes, which differs from the diet quality requirements of wildlife in its natural state.

The nutrient levels of hand-picked forages are usually an unreliable method of assessing the quality of diet selected by wild herbivores (Howery and Pfister 1990). Wild herbivores are in the favourable position of being able to select the parts of the plants that are most nutritious, making hand-picked samples obsolete (Howery and Pfister 1990).

This research forms part of an extensive research project looking into the production potential of eland in the arid parts of southern Africa. With domestication of wildlife becoming more and more lucrative, research is needed into the feeding regime of these mammals. Eland are the largest of the African antelopes (Smithers, 1983) and are sought after for trophies as well as meat production (Skinner, 1967). Furthermore they are used as farm animals in African countries (Skinner, 1967) as well as milking animals in parts of Russia (Skinner, 1966).

Some studies performed in the Republic of South Africa reveal that wildlife tends to select very actively when it comes to diets (Meissner, H.H., Pieterse, Elsje and Potgieter, J.H.J. 1996). This varies over seasons and it emerges that wildlife is adapted to selecting diet according to the animals' physiological status at different times of the year (Meissner *et al.*, 1996). Specific data on diet quality, obtained by methods involving esophageally fistulated animals in free-ranging environments are rare or non-existent in Namibia.

The acceptability and palatability of herbage is determined by the plant species, its age or growth stage, digestibility and chemical composition, physical characteristics such as hairiness, thorniness, etc., its content of repugnant chemicals such as tannin, and the climate and soils (Meissner, H.H., Zacharias, P.J.K. and O'Reagain, P.J. 1999).

MATERIALS AND METHODS

The study was performed at Sonop Research Station of the Ministry of Agriculture, Water and Rural Development in Namibia. The station is located at approximately 18° 55' S and 19° 25' E, 120 kilometers north-east of Grootfontein, the nearest major town, and 600 kilometers north of Windhoek the capital of Namibia. It lies in the semi-arid part of southern Africa, with a mean annual precipitation of 532 mm (20 inches) per year. The rainy season is mainly concentrated during January to April. Rainfall is patchy and irregular, with great variations within and between years. From May to October there is no precipitation and vegetation has to survive on reserves accumulated during the rainy season.

The station covers an area of 11000 hectare and is enclosed by a three meter high game-proof fence. The farm is divided into two halves by a district road running west to east . The research station is part of the Kalahari sand savanna vegetation area of northern Namibia (Giess, 1971). The topography is dominated by stabilized dunes with an elevation of three to five meters separated by inter-dune valleys. Dunes and valleys run in a west-east direction.

The vegetation of the research station consists of 82 identified woody species, 152 species of herbaceous plants and 85 species of the family *Poaceae* (Strohbach and Müller,

1990). The woody vegetation most prevalent on the dunes is *Bauhinia petersiana* subsp. *macrantha, Baphia massaiensis* subsp. *obovata, Grewia flavescens, Commiphora angolensis, Croton gratissimus* subsp. *gratissimus, Ochna pulchra, Combretum collinum, Lonchocarpus nelsii* and *Terminalia sericia*.

The interdune valleys are more open and the more prevalent woody vegetation includes *Acacia mellifera, Rhigosum brevispinosum, Bauhinia petersiana* subsp. *macrantha, Combretum engleri, Ozoroa paniculosa, Baphia massaiensis* subsp. *obovata* and *Acacia erioloba*.

Three eland were tamed from two weeks of age, and at 18 months of age were esophageally fistulated. Two heifers and a bull underwent the operation and subsequent treatment, using the method described by Chapman and Hamilton (1962). The animals were given two months to recuperate from the operation before data sampling commenced. From May 1991 until May 1994 the animals were subjected to diet sampling. This was performed by placing them in predescribed paddocks of 200–250 hectare in size.

The sampling was performed once a month, for one hour during the early morning and one hour during the late afternoon, and samples taken during that day were compared, and mixed if contents were similar. This was performed by removing the esophageal plugs and hanging a bag around the neck of each animal, the method described by Cook, C.W., Thorne, J.L., Blake, J.T., and Edelfsen, J. (1958). In the pretrial period of the project, during which the animals were habituated to the sampling procedure, they had learned to accept the bags. The diet was then sampled using the method described by Bath, D.L., Weir, W.C, and Torell, D.T. (1956).

The animals were not subjected to starvation before the sampling, but were taken from the paddocks for the application of the sampling apparatus, and then set free to roam the paddock at will. Assistants followed them and made use of the subjective sampling method to determine the correlation between the subjective procedure and the esophageal fistula procedure.

Samples were mixed thoroughly, frozen and sent to the laboratory for analysis. Crude protein was determined by analysing for nitrogen, using the Kjeldahl method, by titration after distillation (A.O.A.C. 1975). Crude protein was estimated by multiplying the nitrogen value by 6,25. The crude fibre content of the samples was determined by the method described by Goering and van Soest (1970). The crude fat content was determined by using the Soxhlet extraction method.

The acid detergent fibre (ADF) was determined by boiling the sample with a sulphuric acid solution of cetyltrimethylammonium bromide (CTAB). The insoluble matter remaining on the filter consisted mainly of lignocellulose and silica.

Statistical analysis of the data was performed, making use of a One Way Analysis of variance, a Kruskal-Wallis One Way Analysis of variance in ranks, and an All Pairwise Multiple Comparison Procedures through the Tukey Test and Dunn's Method (Steel and Torrie, 1980).

RESULTS

It can be observed from Figure 1 that protein contents in the diet of eland fluctuated throughout the year. Peaks, however, occured during the months of October to February of each year. This is the period of highest precipitation in the northern regions of Namibia. It is also during this period that eland consume vegetation such as *Baphia massaiensis*, *Bauhinia petersiana*, species of the family *Poaceae*, *Lonchocarpus nelsii* and *Combretum collinum* as well as a number of herbs.

From this data it is established that eland are very selective about the quality of the diet they consume during particular times of the season and year. Protein concentrations tended to form a rhythmic curve during the consecutive years, indicating that, depending on the quality of the rainy season,

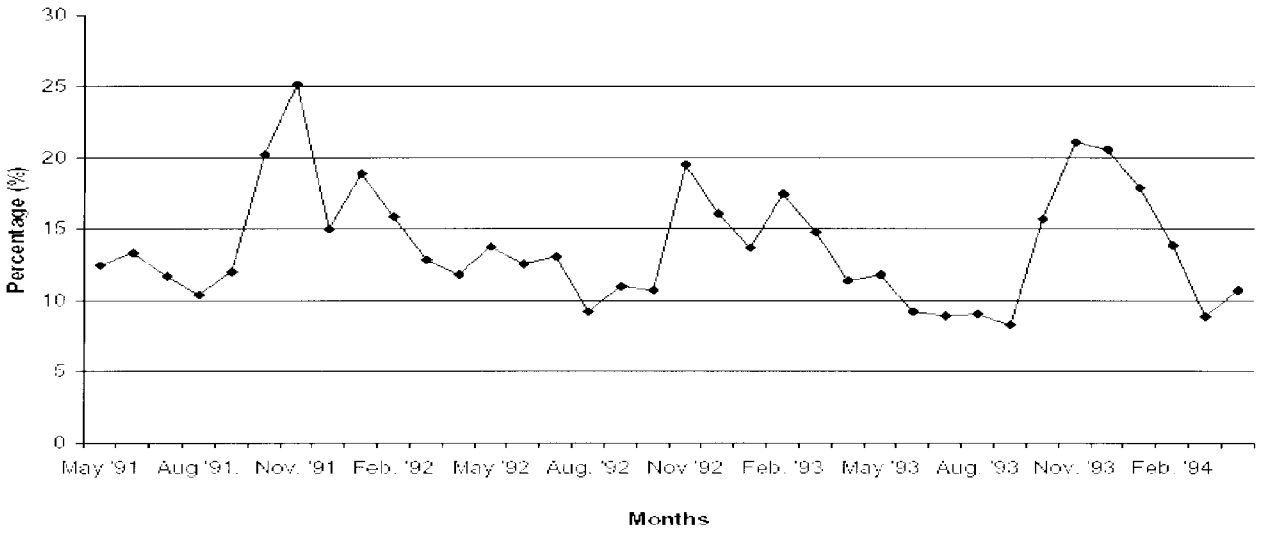

Figure 1. Protein concentrations in the diet of the eland at Sonop Research Station (1991–1993).

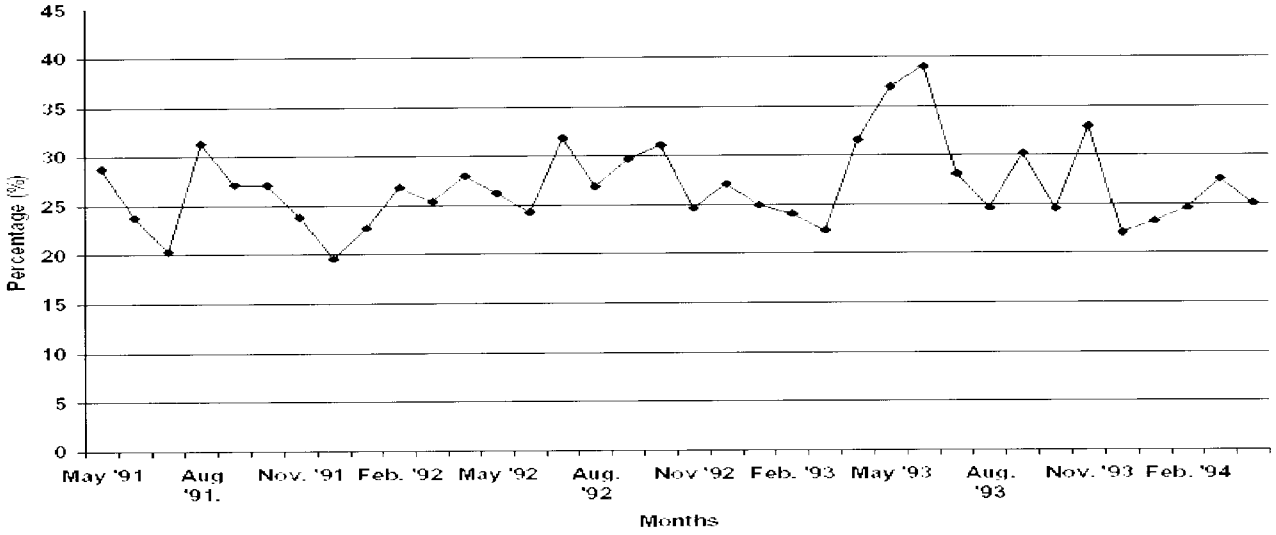

Figure 2. Fibre concentrations in the diet of the eland at Sonop Research Station (1991–1993).

eland are able to select browse of a higher protein content than the average available in the browse.

A One Way Analysis of the data on the protein contents was performed to determine variance, and the normality test failed. A Kruskal-Wallis One Way Analysis of variance in ranks revealed that there was a statistically significant difference for calcium over the various months ($P < 0.001$).

Figure 2 depicts the crude fibre contents on a monthly basis over the three-year period. It can be observed from the figure that fibre concentrations, as in the case of protein concentrations, also tended to fluctuate during the year. This was due to the selection by the animals during certain periods of the year and the concentrations of crude fibre in the plant species. There tended to be peaks during the months of July and August for the first two years under observation, but during the third year the concentrations tended to fluctuate more than during the first two years. The percentage crude fibre varied from 19,55% during the month of December 1991, the wetter part of the season, when vegetation tends to be active, i.e. good growth and reproduction, to 39.00% during the month of June 1993, the dry part of the year, when vegetation tends to be dry, very inactive and lose its leaves.

A One Way Analysis of the data on the crude fibre contents was performed to determine variance, and the normality test failed. A Kruskal-Wallis One Way Analysis of variance in ranks revealed that there was a statistically significant difference for crude fibre over the various months ($P < 0.001$).

Figure 3 depicts the fat contents on a monthly basis over the three-year period. It can be observed from Figure 3 that fat concentrations, as in the case of protein and crude fibre concentrations, also tended to fluctuate during the year. There was no trend of fat concentrations during the various months, except in the month of July 1991, the months of February to June 1992 and the month of April 1994, when fat contents were higher than they were in the other months.

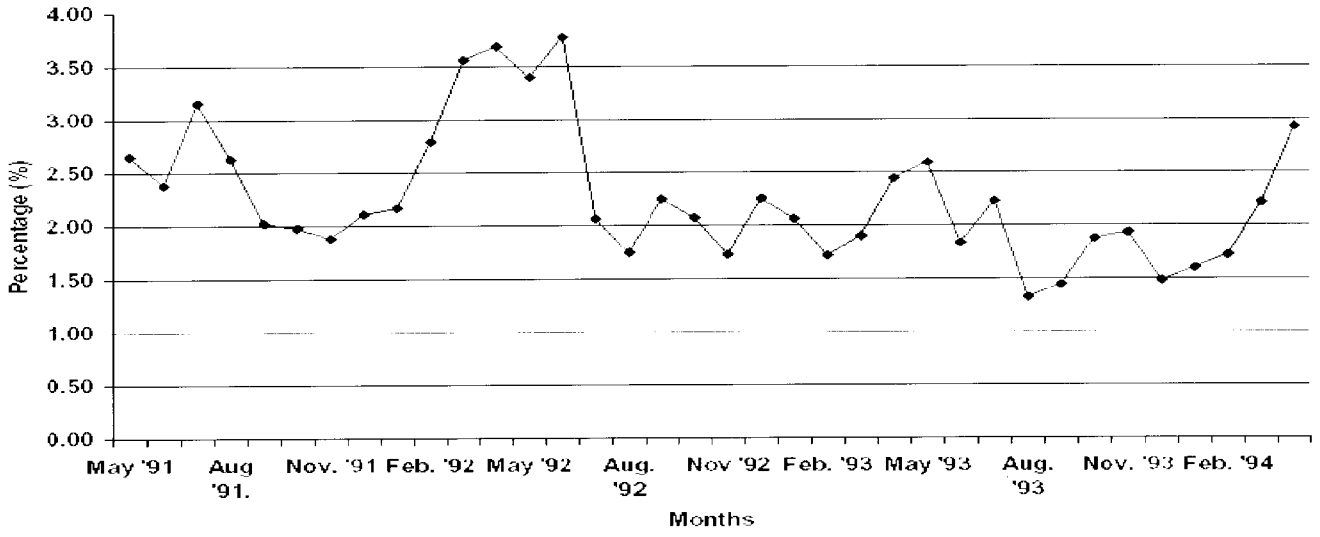

Figure 3. Fat concentrations in the diet of the eland at the Sonop Research Station (1991–1993).

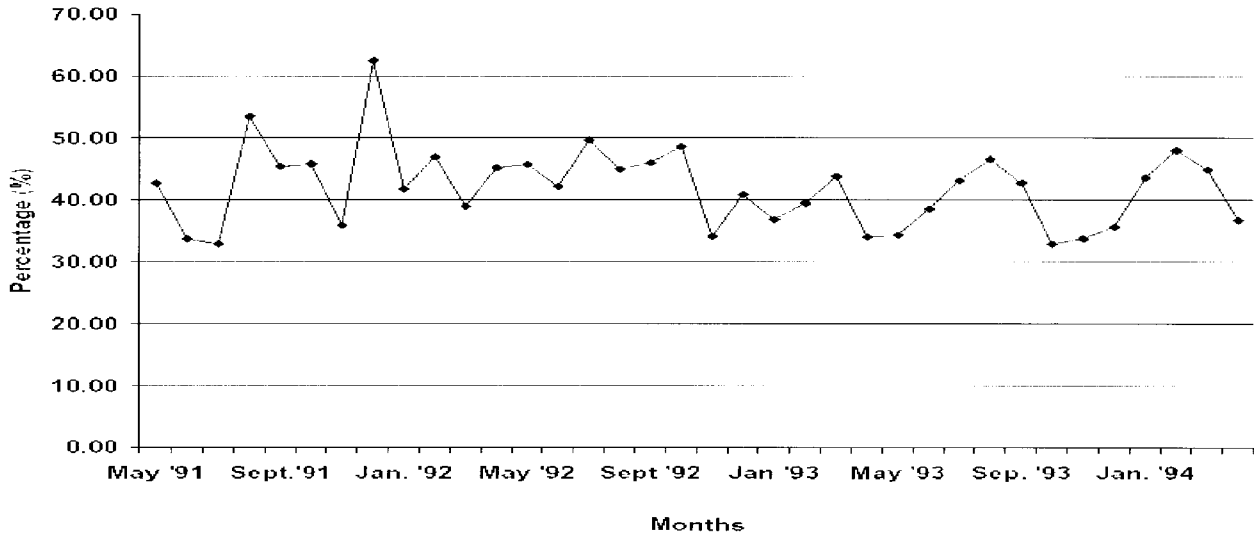

Figure 4. ADF concentrations in the diet of the eland at Sonop Research Station (1991–1993).

The percentage of fat varied from 1,32% during the month of August 1993 to 3.77% during the month of June 1992, which are both dry periods of the year, when vegetation tends to be dry, very inactive and lose its leaves.

A One Way Analysis of the data on the fat contents was performed to determine the variance, and the normality test failed. A Kruskal-Wallis One Way Analysis of variance in ranks revealed that there was a statistically significant difference for crude fibre over the various months ($P \leq 0.001$).

Figure 4 depicts the Acid Detergent Fibre (ADF) contents on a monthly basis over the three-year period. It can be observed from the figure that ADF contents, as with protein, crude fibre and fat concentrations, also tended to fluctuate during the year. There was, however, as in the case of the fat content, no trend of ADF concentrations during the various months, except in the months of August and December 1991, when ADF contents were higher than in the other months.

The percentage of ADF varied from 32,83% during the month of October 1993, the drier time of the year, to 62,49% during the month of December 1991, the moister time of the year, when vegetation tends to become green, active but not vigorous in growth yet.

A One Way Analysis of the data of the ADF contents was performed to determine the variance, and the normality test failed. A Kruskal-Wallis One Way Analysis of variance in ranks revealed that there was a statistically significant difference for ADF contents over the various months ($P \leq 0.001$).

DISCUSSION

With great seasonal variances in the nutritive value of the vegetation of the African savannas, its chemical composition varies from season to season (Meissner *et al.* 1999). Joubert (1974) stated that this is the case in Namibia as well, and that the nutritive value would therefore have to be determined separately during each of the seasons. With variances in the monthly and annual precipitation, variations in nutritive values for specific months would therefore also differ.

From the results presented it can be seen that eland are very selective when it comes to the nutritive value of the vegetation consumed. The area where most eland are found in Namibia is, according to aerial censuses, in the area where this research was performed (Ministry of Environment reports, 1999). The soils in this area are very sandy and low in nutritive value (FAO UNESCO, 1973). It is therefore even more difficult for eland to select for vegetation with the nutritive value, the animal requires for growth, maintenance and reproductive activities.

From studies performed in southern Africa, specifically looking into the chemical contents of the diet of the eland, it was found that crude protein (CP) concentrations fluctuated between 8,06 and 11,53% (Buys, 1990). In his study Buys further indicated that the CP level started increasing in late winter and reached a peak during December. In our study, the CP started increasing only during spring and peaked during November. It should be taken into consideration that the study area for Buys's project (1990) received earlier rains than our study area. Furthermore, the peak values of crude protein concentrations were much higher (25,12; 19,49; 21,48%) in Buys's study, but the lowest values correspond well with our study (8,03%).

Arman, Hopcraft and McDonald (1975) and Zimmerman (1978) stated that when forage other than grass is included in the diet of an animal, the nitrogen content of faeces is not an accurate indicator of actual protein intake. Although there are inaccuracies in the estimation of protein intake from faecal nitrogen, the method has potential for monitoring trends in ruminant dietary quality (Holechek, Vavra and Pieper, 1982). Erasmus, T., Penzhorn, B.L. and Fairall N. (1978) and Robbins (1983) indicated that this method could be used as a very general indicator of protein intake in relation to qualitative seasonal changes. This explains the difference in values between the study of Buys (1990), in which faecal

analysis was performed, in contrast to our study, in which esophageally collected material was used in the determination of protein intake.

Crude protein levels in the diet of other wildlife species, such as the impala (*Aepyceros melampus*) and the nyala (*Tragelaphus angasi*) varied from 9,3 to 16,4% and 9,2 to 14,0% respectively (van Rooyen, 1992). Meissner *et al.* (1996) recorded crude protein concentrations of between 7,27 and 9,83% in the diet of impala. Els (2000) found that for small stock animals in southern Namibia, i.e. the Angora goat, the Dorper sheep, the Karakul sheep and the Merino sheep, the crude protein concentrations in their diet were 11,485; 10,505; 8,470 and 9,465% respectively.

Crude fibre contents in Buys's (1990) study of eland fluctuated between 22 and 44%. The percentage of crude fibre varied from 19,55 to 39.00% in our study, which corresponds well with Buys's findings. Fibre contents in the diet of other wildlife in southern Africa were between 35,2 and 40,9% for impala and between 35,1 and 42,8% for nyala (van Rooyen, 1992).

Studies by Mac Leod, S.B., Kerley, G.I.H. and Gaylard, A. (1996) put crude fibre contents in the diet of the bushbuck (*Tragelaphus scriptus*) at between 33,9 and 52,3%, which is considerably higher than the values for eland in this study.

Fat concentrations in the diet of the eland in this study fluctuated from 1,32 to 3,77%, and did not form any trend. A comparison with other wildlife species in southern Africa was difficult to make, due to the unavailability of such data on other wildlife species.

In the study by Buys (1990) acid detergent fibre (ADF) values for eland fluctuated from 22% after the start of rains to 62% during the late winter months, in comparison with our study, in which ADF values fluctuated between 32,83 and 62,49%. ADF values did, however, fluctuate greatly during this study and no pattern according to season could be determined. ADF values for impala in the Meissner *et al* (1996) study did not vary as much (35,8–41,9%). The Angora goat, the Dorper sheep, the Karakul sheep and the Merino sheep study by Els (2000) revealed ADF values of 41,48; 39,65; 44,61 and 44,31 respectively.

From the data presented it can be observed that eland are very selective in the diet they utilize, and that the chemical composition of the diet shows this very clearly. With the development of feeds for use in feeding domesticated eland, this should be taken into consideration, so that they are fed according to their dietary requirements.

CONCLUSIONS

The chemical properties of the species consumed by eland are very important in determining the quality of feed that they need. A number of farmers in Namibia are diversifying ranching operations because high risks involved when farming in as fragile an ecology as Namibia's. From the study results it can be concluded that eland are very specific in the quality of diet they utilize throughout the year.

Crude protein values in this study compared well with other studies performed in southern Africa, specifically looking into the chemical contents in the diet of eland. There were diets of other wildlife species, such as the impala (*Aepyceros melampus*) and the nyala (*Tragelaphus angasi*), in which these values varied from 9,3 to 16,4% and 9,2 to 14,0% respectively. For small stock animals in southern Namibia, i.e. the Angora goat, the Dorper sheep, the Karakul sheep and the Merino sheep, the crude protein concentrations in the diet were 11,485; 10,505; 8,470 and 9,465% respectively.

This once again shows the importance of diet quality for different animals and that farmers need to take this into consideration when feeding animals, especially during drought conditions, which occur frequently in southern Africa. In multi-species wildlife systems in Namibia, farmers give the animals the same feed, irrespective of the animal species. The farmers then complain to scientists that animals are deteriorating even further although they are being fed. What is not taken into consideration is that animals have different feeding regimes so the feed needs to be correlated to the regimes.

Fat concentrations in the diet of the eland in this study fluctuated from 1,32 to 3,77%, and did not form any trend. A comparison with other wildlife species in southern Africa was difficult to make, due to the unavailability of such data on other wildlife species. It can be concluded that fat concentrations are not of such a high priority as proteins and fibre in determining when protein and fibre concentrations need to be increased during the peak times of the year when animals select for them.

Acid detergent fibre (ADF) values in the diet of the eland in our study fluctuated between 32,83 and 62,49%. ADF values, however, fluctuated greatly during this study and no pattern according to season could be determined. Values were higher than for the diets of other wildlife species, showing once again that this is an important factor to be taken into consideration when formulating feeds for eland under ranching conditions.

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