CHAPTER 5

HABITAT PREFERENCE AND STATUS OF THE NYALA IN TEMBE ELEPHANT PARK, SOUTH AFRICA

INTRODUCTION

The nyala is a member of the family Bovidae and the exclusively African tribe Tragelaphini (Grubb 1993; Estes 1997). The name nyala is derived from the Zulu name “inxala” that was given to it in South Africa. Gray first described it scientifically in 1849 (Skinner & Smithers 1990; Fürstenburg 2002). Other species in this tribe include the bushbuck *Tragelaphus scriptus*, sitatunga *Tragelaphus spekii*, mountain nyala *Tragelaphus buxtoni*, greater kudu *Tragelaphus strepsiceros*, lesser kudu *Tragelaphus imberbis*, bongo *Tragelaphus eurycerus*, southern eland *Taurotragus oryx* and Derby’s eland *Taurotragus derbianus* (Grubb 1993; Estes 1997; Fürstenburg 2002). Tribal traits include a medium-sized to large body, spiralled horns, white vertical stripes and a pronounced sexual dimorphism.

The basic social group of the nyala is the family unit, which consists of an adult female and her offspring, while males are usually solitary (Anderson 1980). Several authors have described the nyala as being primarily or predominantly a browser, although it includes a fair amount of grass in its diet when grass is available (Vincent *et al*. 1968; Anderson & Pooley 1977). Van Rooyen (1990) showed that the nyala in the Ndumu Game Reserve is flexible when selecting food items and that it selects a diet that varies according to season as influenced by rainfall. The nyala can therefore be defined as an intermediate feeder that prefers browse but who will graze to a large extent only during the initial period of fresh growth following the onset of the summer rains.

The nyala occurs in the southeastern parts of the African continent and has a localised distribution because of its habitat requirements. The distribution of the nyala closely corresponds with the Mozambique Coastal Plain and valleys of the major rivers in this area but this distribution has been greatly reduced in recent years and the nyala has become isolated within the last century (Estes 1997). Today the nyala is found naturally in the hot, low-lying areas of northern and southern Zimbabwe, Mozambique and in the Limpopo, Mpumalanga and KwaZulu-Natal provinces of South Africa. However, it has recently been translocated to numerous private reserves and wildlife ranches in southern Africa, with Ezemvelo KwaZulu-Natal Wildlife translocating more than 8 000 nyala over the past 25 years alone (Mills & Hes 1997). When translocated outside its normal distributional range, the nyala

competes successfully with ecologically close species like the bushbuck. In several parks and reserves it has been necessary to control the populations of nyala for some time to prevent the overutilisation of a number of plant communities. The demand for the nyala for trophy hunting has also led to the improvement of its status outside reserves and national parks, and viable populations are present on several privately owned ranches because of its economic value (Mills & Hes 1997).

Knowledge of the habitat preference and conservation status of large herbivores is basic to any management programme for a reserve and a pre-requisite to determine stocking densities and possible translocations (Dekker *et al*. 1996). Stocking density is the area of land allocated per animal unit (Tainton 1999). The optimal stocking density of various species depends on the available habitat, the quality of the habitat and the objectives of use (Van Rooyen *et al*. 1996). A sound knowledge of the diet and factors affecting it are also crucial to understanding ungulate ecology and management (Van Rooyen 1990). The fact that most species are linked to major vegetation types helps in understanding their distribution patterns (Pienaar 1974).

In the present study, we tested the hypothesis that the nyala responded to the variables in its physical habitat in proportion to its availability within the Tembe Elephant Park. If the nyala showed a preference of use for certain vegetation types, then the suitability of different areas can be determined for the nyala by evaluating the physical characteristics of the preferred vegetation types. More accurate stocking densities can then also be determined based on the habitat preferences of the nyala. The objective of the present study was therefore to gather information on the habitat preference and conservation status of the nyala within the park. This information is crucial for the effective management of the nyala population in the park, as well as for future reintroductions of nyala to neighbouring areas.

METHODS

The methods presented below are restricted to the broad outlines of the methods employed. For a more detailed description of the methods, please refer to the general methods in chapter 3.

Habitat preference

Road counts of the spatial distribution of the nyala were done in Tembe from December 2002 to November 2003. The study area was surveyed four times per month for a full year. All the observations were documented on a field form and the closest coordinates of the position of an observed nyala was determined by using

geographic positioning equipment (GPS). All the data were captured on a computer database for further analysis.

A measure of habitat preference for the nyala was obtained by comparing patterns of habitat use with habitat availability within the study area. The Index of Jacobs (1974) was then used to calculate a preference index of use (*P*) for each vegetation type. The preference index only provided a ratio of habitat use to habitat availability and was not based on a statistical test. This was overcome by performing a Chi-square goodness-of-fit test. When a significant difference in use versus availability was detected, a Bonferroni *Z*-statistic was used to determine which vegetation types were used more or less often than expected by constructing 95% simultaneous confidence intervals around the proportion of the nyala recorded in each vegetation type (Beyers *et al*. 1984; Allredge & Ratti 1992; Pienaar *et al*. 1992).

Direct observations of feeding were also made to identify the preferred height and plant species that were being browsed by the nyala in Tembe. Plant species were identified either while the animal was actually feeding, or by site inspection once it had moved on. If a plant species could not be identified in the field, a sample was taken for later identification. Feeding records were taken during diurnal activity only.

Population status

An aerial survey that was done in October 2003 was used to determine the current population status of the nyala in Tembe. The overall aim of the survey was to derive trends and estimates of the large herbivore populations in Tembe that would be useful for management decisions and would stand as a record of abundance for future trend analyses. Total aerial counts and transect distance sampling counts were used to estimate the number of nyala in Tembe and to calculate trends in the population from 1993 to 2003 (Matthews 2004).

RESULTS

Habitat preference

A total of 724 observations were recorded during the study period. The nyala was most often found in Closed Woodland/Thicket Mosaic on sand (31.5% of observations) and Open Woodland (30.4%), less often in Closed Woodland on clay (13.4%), Sand Forest/Grassland Mosaic (13.3%) and *Acacia borleae* Shrubland/Bush Clump Mosaic on clay (10.8%), and least often in Hygrophilous Grassland (0.6%) and the Muzi Swamp (0.1%). The nyala was never found in Old Lands or in Sparse Woodland (Table 3). The Chi-square goodness-of-fit test for the

Table 3. Vegetation types in Tembe Elephant Park, South Africa, their respective sizes (km²), proportion of the available habitat, proportion of use by the nyala and preference index of use by the nyala from December 2002 to November 2003.

Number	Vegetation type	Size (km²)	Percentage of available habitat (*A*)	Percentage of use (*U*)	Preference index (*P*)
1	*Acacia borleae* Shrubland/Bush Clump Mosaic on clay	2.3	0.7	10.8	0.935
2	Closed Woodland/Thicket Mosaic on sand	51.8	15.0	31.4	0.524
3	Closed Woodland on clay	8.7	2.5	13.4	0.813
4	Hygrophilous Grassland	6.7	2.0	0.6	-0.700
5	Muzi Swamp	3.4	1.0	0.1	-0.900
6	Old Lands	0.6	0.2	0.0	-1.000
7	Open Woodland	91.5	26.6	30.4	0.125
8	Sand Forest/Grassland Mosaic	164.8	47.8	13.3	-0.722
9	Sparse Woodland	14.4	4.2	0.0	-1.000

overall data set showed a significant difference (χ^2= 242.817; $p \leq 0.05$; df = 8) in use versus availability for the different vegetation types in Tembe. The preference index of use of vegetation types by the nyala in Tembe indicated vegetation types 1, 2 and 3 as being preferred for use, vegetation types 4, 5, 6, 8 and 9 as not being preferred and vegetation type 7 as being used in the same ratio as its proportional occurrence (Table 4).

Based on 102 feeding observations, a total of 29 plant species was browsed by the nyala in Tembe (Table 5). Generally, only the leaves of the food plants were eaten, although shoots, flowers and fruit were also eaten sporadically. Browsing height was predominantly from 0.5 m to 1.5 m (74.5% of all the observations) with 20.6% of feeding observations at a height < 0.5 m and 4.9% > 1.5 m. Using the number of times that a nyala was observed feeding on a particular species as a measure of the frequency of consumption, *Grewia caffra* (21.6%), *Strychnos madagascariensis* (17.7%) and *Strychnos spinosa* (13.7%) were the most commonly eaten plants (Table 5). During field observations the nyala was also observed eating fresh green grass sprouting after rain.

Population status

During the total aerial count, 584 nyala were recorded in 178 groups. Based on the distance sample estimate this indicated a population of 1341 individuals, which is the current estimate for the nyala population in Tembe (Matthews 2004). Population trends appear to indicate an increase in the nyala population, from a total aerial count of 45 individuals in 1993 to the 584 in 2003 (Figure 12).

DISCUSSION

Habitat preference

The nyala in Tembe showed a preference of use for the *Acacia borleae* Shrubland/Bush Clump Mosaic on clay, the Closed Woodland/Thicket Mosaic on sand and the Closed Woodland on clay. No observations of the nyala were ever recorded in the Old Lands and the Sparse Woodland and these vegetation types are clearly not being used. The Hygrophilous Grassland, Muzi Swamp and Sand Forest/Grassland Mosaic were also not being used often and the Open Woodland was used in proportion to its availability.

Table 4. The preference of use of the vegetation types in Tembe Elephant Park, South Africa by the nyala from December 2002 to November 2003 ($\alpha = 0.05$; $k = 9$; $Z_{1-\alpha/2k} = 2.75$)

Vegetation type*	Percentage of habitat	Chi-square contribution	Confidence interval	Habitat use
1	0.7	145.7	$0.076 \leq p_1 \leq 0.140$	Prefer
2	15	17.9	$0.268 \leq p_2 \leq 0.362$	Prefer
3	2.5	47.5	$0.099 \leq p_3 \leq 0.169$	Prefer
4	2.0	0.9	$-0.002 \leq p_4 \leq 0.014$	Not used
5	1.0	0.8	$-0.002 \leq p_5 \leq 0.004$	Not used
6	0.2	0.2	$0.000 \leq p_6 \leq 0.000$	Not used
7	26.6	0.5	$0.257 \leq p_7 \leq 0.351$	No pattern
8	47.8	24.9	$0.098 \leq p_8 \leq 0.168$	Not used
9	4.2	4.2	$0.000 \leq p_9 \leq 0.000$	Not used
Total	100	242.6	-	-

*Vegetation type numbers correspond with Figure 5 in chapter 2, and Table 3.

Table 5. The percentage occurrence of various plant species in the diet of the nyala based on 102 feeding observations from December 2002 to November 2003 in Tembe Elephant Park, South Africa.

Plant species	Actual observations	Percentage of occurrence
Acacia borleae	1	1.0
Acacia burkei	5	4.9
Afzelia quanzensis	1	1.0
Albizia versicolor	1	1.0
Brachylaena discolor	1	1.0
Bridelia cathartica	2	2.0
Carissa bispinosa	1	1.0
Coddia rudis	1	1.0
Commelina africana	1	1.0
Dialium schlechteri	3	2.9
Dichrostachys cinerea	5	4.9
Euclea natalensis	1	1.0
Gardenia volkensii	1	1.0
Grewia caffra	22	21.6
Helichrysum kraussii	1	1.0
Jasminum breviflorum	3	2.9
Margaritaria discoidea	1	1.0
Mundulea sericea	1	1.0
Pollichia campestris	1	1.0
Psydrax locuples	1	1.0
Pteleopsis myrtifolia	1	1.0
Rhus lucida	1	1.0
Senecio pleistocephalus	6	5.9
Strychnos madagascariensis	18	17.7
Strychnos spinosa	14	13.7
Tabernaemontana elegans	3	2.9
Trichilia emetica	2	2.0
Vepris lanceolata	1	1.0
Vernonia colorata	2	2.0

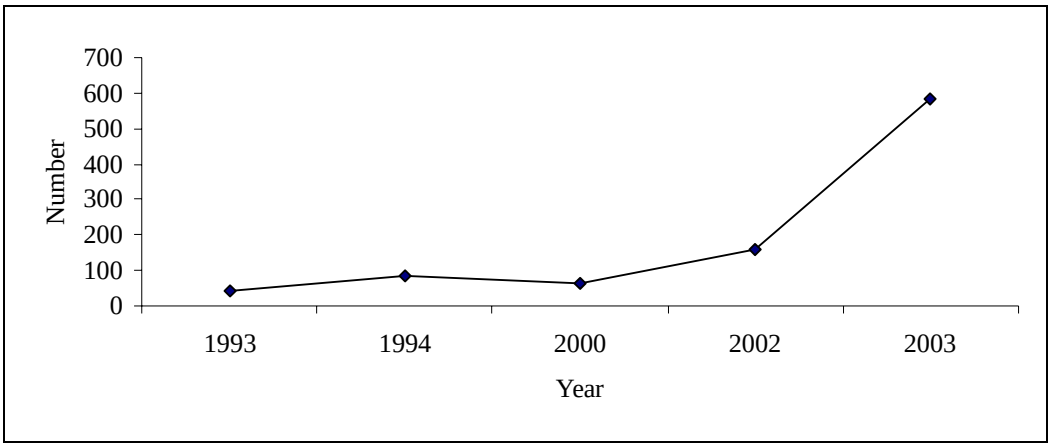

Figure 12: Aerial survey of the nyala as based on total counts conducted in Tembe Elephant Park, South Africa from 1993 to 2003. Source: Matthews *et al*. (2004).

The *Acacia borleae* Shrubland/Bush Clump Mosaic on clay occurs next to marshy areas and clay-based thickets associated with the Muzi Swamp. In structure this vegetation type varied from areas of dense vegetation to thickets that were associated with termitaria. Moreover, perennial pans were found interspersed throughout these clay areas (Matthews *et al*. 2001). Of all the observations of the nyala, 10.8% were in this vegetation type but it only comprised < 1% of the total available habitat.

The Closed Woodland/Thicket Mosaic on sand occurs on the dune crests, slopes and interdune depressions throughout Tembe and can be distinguished based on plant density, which in most cases varied from closed to semi-closed crown gaps and a canopy that varied from approximately 8 to 12 m in height. The nyala reached its highest density (31.5%) in this vegetation type.

The Closed Woodland on clay occurs on soils that were normally associated with bottomlands of dunes (Matthews *et al*. 2001). Although this vegetation type only covered 2.5% of the surface area of Tembe, 13.4% of observations of the nyala were made there. The shrub *Grewia caffra* showed a strong affinity to all three of these above vegetation types (Matthews *et al*. 2001) and was the most commonly used plant species for browse by the nyala in Tembe. The presence of dense vegetation or thickets, and to a lesser degree of perennial pans, seemed to play an important role in the distribution of the nyala and their preference towards certain vegetation types in Tembe.

The Sparse Woodland mainly occurs on the flat areas between the dunes, but also to a lesser degree on the dune slopes and crests throughout Tembe (Matthews *et al*. 2001). This vegetation type was in effect a grassland that was characterised by an abundance of shrub species that produced annual leafy and flowering shoots from a perennial, underground woody rootstock and has few large trees. Even though the nyala occurred in a wide variety of habitats, various studies have shown that the presence of cover in the form of dense vegetation is vital (Vincent *et al*. 1968; Anderson 1978; Skinner & Smithers 1990; Van Rooyen 1990). The open nature of the Old Lands and the Sparse Woodland were therefore the most likely reason why the nyala did not use these habitat types in Tembe.

No preference of use was shown towards the Hygrophilous Grassland that occurs adjacent to the Muzi Swamp, the Muzi Swamp itself or the Sand Forest/Grassland Mosaic. The Hygrophilous Grassland and the Muzi Swamp have a grassland structure with no abundant trees or thickets (Matthews *et al*. 2001). The Sand Forest/Grassland Mosaic was the largest vegetation type in Tembe and was mostly associated with dunes. This vegetation type was structurally classified as a

forest that was interspersed with grassland (Matthews *et al*. 2001). The grasslands there were open with little to no trees and shrubs. It gradually acquired a more open woodland character further away from the Sand Forest. Of all the observations recorded for the nyala, 13.3% were in this vegetation type. Although the nyala has been shown to occur in the open, as in other studies they were always close to dense vegetation and made straight for the nearest cover when disturbed (Vincent *et al*. 1968; Skinner & Smithers 1990).

The Open Woodland was the second largest vegetation type in Tembe and it occurs on the dune crests, slopes and interdune depressions throughout the park. It has a small number of trees of approximately 8 to 10 m tall scattered throughout a well-developed grass layer. Abundant trees in this vegetation type included *Albizia versicolor*, *Strychnos madagascariensis* (the second most abundant woody plant used by the nyala), *Combretum molle*, and *Terminalia sericea* (Matthews *et al*. 2001). The second highest occurrence of the nyala (30.4% of all observations) was in this vegetation type. Although the nyala was often observed in the Open Woodland during field observations, the overall density of the nyala there was low because of the size of this vegetation type and it was used by the nyala in the same ratio as its proportional occurrence in Tembe.

The habitat of ungulates provides them with food, water and cover, and the feeding style of each species is therefore of primary importance in determining its preferred habitat (Van Rooyen 1990). Species in the tribe Tragelaphini have diets that include a high proportion of dicotyledonous plants (Gagnon & Chew 2000), and the nyala is no exception. The nyala is, however, flexible when selecting food items due to the influence of rainfall and shows considerable variation in dicotyledonous intake according to the season, from 18.7% in November to 81.9% in July (Van Rooyen 1990). Of the 29 plant species identified as being browsed by the nyala in Tembe, six accounted for 68.7% of the feeding observations on the nyala (Table 3). These plant species also reached their highest abundance within one or more of the vegetation types preferred for use by the nyala in Tembe (Matthews *et al*. 2001). Furthermore, all these plant species were recorded in rumen analyses of the nyala in Ndumo Game Reserve (Anderson & Pooley 1977) and are thus considered to be important in the diet of the nyala.

Population status

The population of the nyala in Tembe is currently estimated at 1341 individuals, possibly the first reliable estimate for the nyala in Tembe (Matthews *et al*. 2001). With the nyala, animal density is not a primary function of social spatial behaviour but

rather of food and habitat suitability. Therefore, nyala density can vary from 0.7 nyala/ha to 0.03 nyala/ha with the maximum recommended density being 0.4 nyala/ha under optimal conditions (Fürstenburg 2002). The nyala population in a given area should therefore be controlled in order to prevent the overutilization of their preferred habitat. The influence of the nyala on its preferred habitat should also be monitored, especially where less abundant species share these habitat preferences. In Tembe, 6280 ha of preferred habitat (vegetation types 1, 2 and 3) are available. This equates to an estimated maximum recommended stocking density of 2512 nyala based on habitat availability. The expected population growth rate for the nyala is 28% per year (Fürstenburg 2002). Should no control of the nyala population in Tembe take place, the current estimated population is likely to reach the maximum recommended stocking density within 3 years. In order to keep the nyala population in Tembe at its current level, 375 individuals will have to be removed annually based on the expected population growth rate, whether this is through predation, culling, live capture for translocation or other causes.

Since most harvesting programmes disrupt animal herds, it should be done at a time that will have the least effect on reproduction. Animals should not be disturbed just before, during or immediately after the lambing season (Bothma 2002). The nyala breed year-round with two breeding peaks in autumn and spring (Van Rooyen 1990; Estes 1997). The best time to harvest it would therefore be during May or June. Apart from being the least disruptive on reproduction, this will have the added advantage of reducing the nyala population before late winter when food is in short supply. The removal of lone female nyala should be avoided since they might have hidden calves. Instead the removal of complete female units must be attempted. Male nyala will probably be encountered in relation to the proportional age distribution of the population and should be removed accordingly. The nyala is unlikely to change its existing range use pattern and harvesting should thus be confined to areas with visible habitat degradation (Anderson 1978).

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