# CHAPTER 8

## HABITAT PREFERENCE AND STATUS OF THE GREATER KUDU IN TEMBE ELEPHANT PARK, SOUTH AFRICA

### INTRODUCTION

The greater kudu is a member of the family Bovidae and the exclusively African tribe Tragelaphini (Grubb 1993; Estes 1997). The name kudu is derived from the Khoikhoi name “ku:du” that was given to it in South Africa. Pallas first described it scientifically in 1766 from a specimen from the Cape of Good Hope (Skinner & Smithers 1990). Other species in this tribe include the bushbuck *Tragelaphus scriptus*, sitatunga *Tragelaphus spekii*, nyala *Tragelaphus angasii*, mountain nyala *Tragelaphus buxtoni*, lesser kudu *Tragelaphus imberbis*, bongo *Tragelaphus eurycerus*, southern eland *Taurotragus oryx* and Derby’s eland *Taurotragus derbianus* (Grubb 1993; Estes 1997). Tribal traits include a medium-sized to large body, spiralled horns, white vertical stripes and a pronounced sexual dimorphism. The greater kudu is the tallest antelope after the eland and has the longest horns, reaching a record length of 1.8 m (Estes 1997; Mills & Hes 1997).

The greater kudu is found throughout the drier savanna zones of southern, south- central and eastern Africa south of the Sahara desert. It is a savanna woodland species that does not occur in desert, forest or open grassland areas. It is partial to areas of broken, rocky terrain with a cover of woodland and a water supply nearby (Skinner & Smithers 1990; Friedmann & Daly 2004). Today, it is common throughout the bushveld areas of southern Africa, even outside conservation areas, and it has been extending its range westwards into parts of the Karoo (Mills & Hes 1997). The greater kudu is one of the few large mammals that are capable of surviving close to human settlements. When fleeing, it can clear obstacles like fences up to 2.5 m high (Estes 1997).

The greater kudu is gregarious, with females and their offspring forming cohesive social units and males associating in transient bachelor groups. Herds are usually small, commonly comprising about four animals and rarely up to 20 animals, and occupying overlapping ranges (Skinner & Smithers 1990; Estes 1997). In South Africa, males join female herds in April to May during the mating season, but favour different habitats outside this period. Calves are born in January and February after a gestation period of 9 months, but out of season births are not unusual (Mills & Hes 1997).

Based on its diet, the greater kudu is classified as a generalist feeder, being an animal with a diet that consists of >20% monocotyledonous plant material, >20% dicotyledonous plant material and >20% fruits (Gagnon & Chew 2000). The greater kudu predominantly browses, although it may eat fresh grass and fruit. It eats a greater variety of woody plants than any other bovid occurring in the same region (Skinner & Smithers 1990). During the dry season, when only a few evergreen trees retain their leaves, the greater kudu usually experiences a food shortage. During this time, mortalities are higher in males than in females. Old and young animals are also more severely affected by droughts and diseases than mature animals. Nevertheless, the greater kudu population recovers rapidly after such die-offs and it remains common, even outside formally conserved areas (Owen-Smith 1997).

Knowledge of the habitat preference and the conservation status of large herbivores is basic to any management programme for a reserve, and it is also 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. 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 greater kudu responded to the variables in its physical habitat in proportion to its availability within the Tembe Elephant Park. If the greater kudu showed a preference of use for certain vegetation types, then the suitability of different areas can be determined for it by evaluating the physical characteristics of the preferred vegetation types. More reliable stocking densities can then also be calculated based on the habitat preferences of the greater kudu. The objectives of the present study were therefore to gather information on the habitat preference and conservation status of the greater kudu within the park. This information is crucial for the effective management of the greater kudu population in the park, as well as for possible future reintroductions 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 greater kudu 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 greater kudu 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 greater kudu 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 greater kudu 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 greater kudu 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 greater kudu 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 greater kudu in Tembe and to calculate trends in the population from 1993 to 2003 (Matthews 2004).

# RESULTS

## Habitat preference

A total of 174 observations were recorded during the study period. The greater kudu was most often found in Open Woodland (43.7% of observations) and Sand Forest/Grassland Mosaic (29.3%), less often in Closed Woodland/Thicket Mosaic on sand (12.6%) and Closed Woodland on clay (9.2%), and least often in Sparse Woodland (2.9%), *Acacia borleae* Shrubland/Bush Clump Mosaic on clay (1.7%) and the Muzi Swamp (0.6%). The greater kudu was never found in the Hygrophilous Grassland or Old Lands (Table 10). The Chi-square goodness-of-fit test for the overall data set showed a significant difference ($\chi^2$= 40.7; $p \leq 0.05$; $df$ = 8) in use versus availability for the different vegetation types in Tembe. The preference index of use of vegetation types by the greater kudu in Tembe indicated vegetation types 3 and 7 to be preferred for use, vegetation types 4, 6 and 8 were not preferred while vegetation types 1, 2, 5 and 9 were used in the same ratio as its proportional occurrence (Table 11).

Based on 86 feeding observations, a total of 31 plant species was browsed by the greater kudu in Tembe (Table 12). Generally, only the leaves of the food plants were eaten, although shoots, flowers and fruit were also eaten sporadically. Browsing height was predominantly from 1.5 to 2 m (67% of all the observations) with 33% of feeding observations at a height < 1.5 m. The mean feeding height was estimated at 1.5 m. Using the number of times that a greater kudu was observed feeding on a particular species as a measure of the frequency of consumption, Strychnos madagascariensis (20.9%), Combretum molle (12.8%), Strychnos spinosa (11.6%) and Acacia burkei (9.3%) were the most commonly eaten plants (Table 12).

## Population status

During the total aerial count, 376 greater kudu were recorded in 75 groups. Based on the distance sample estimate this indicated a population of 780 individuals, which is the current estimate for the greater kudu population in Tembe (Matthews 2004). Population trends indicate an increase in the kudu population from a total aerial count of 27 individuals in 1993 to the 376 in 2003 (Figure 15).

**Table 10.** Vegetation types in Tembe Elephant Park, South Africa, their respective sizes (km²), proportion of the available habitat, proportion of use by the greater kudu and preference index of use by the greater kudu 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 | 1.7 | 0.588 |
| 2 | Closed Woodland/Thicket Mosaic on sand | 51.8 | 15.0 | 12.6 | -0.160 |
| 3 | Closed Woodland on clay | 8.7 | 2.5 | 9.2 | 0.728 |
| 4 | Hygrophilous Grassland | 6.7 | 2.0 | 0.0 | -1.000 |
| 5 | Muzi Swamp | 3.4 | 1.0 | 0.6 | -0.400 |
| 6 | Old Lands | 0.6 | 0.2 | 0.0 | -1.000 |
| 7 | Open Woodland | 91.5 | 26.6 | 43.7 | 0.391 |
| 8 | Sand Forest/Grassland Mosaic | 164.8 | 47.8 | 29.3 | -0.388 |
| 9 | Sparse Woodland | 14.4 | 4.2 | 2.9 | -0.310 |

**Table 11.** The preference of use of the vegetation types in Tembe Elephant Park, South Africa by the greater kudu 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 | 1.4 | $-0.010 \leq p_1 \leq 0.044$ | No pattern |
| 2 | 15 | 0.4 | $0.057 \leq p_2 \leq 0.195$ | No pattern |
| 3 | 2.5 | 18.0 | $0.032 \leq p_3 \leq 0.152$ | Prefer |
| 4 | 2.0 | 2.0 | $0.000 \leq p_4 \leq 0.000$ | Not used |
| 5 | 1.0 | 0.2 | $-0.010 \leq p_5 \leq 0.022$ | No pattern |
| 6 | 0.2 | 0.2 | $0.000 \leq p_6 \leq 0.000$ | Not used |
| 7 | 26.6 | 11.0 | $0.334 \leq p_7 \leq 0.540$ | Prefer |
| 8 | 47.8 | 7.2 | $0.198 \leq p_8 \leq 0.388$ | Not used |
| 9 | 4.2 | 0.4 | $-0.006 \leq p_9 \leq 0.064$ | No pattern |
| Total | 100 | 40.7 | - | - |

*Vegetation type numbers correspond with Figure 5 in chapter 2, and Table 10.

**Table 12.** The percentage occurrence of various plant species in the diet of the greater kudu based on 86 feeding observations from December 2002 to November 2003 in Tembe Elephant Park, South Africa.

| Plant species | Actual observations | Percentage of occurrence |
|---|---|---|
| *Acacia burkei* | 8 | 9.3 |
| *Acacia nilotica* | 1 | 1.2 |
| *Afzelia quanzensis* | 1 | 1.2 |
| *Aloe marlothii* | 1 | 1.2 |
| *Brachylaena discolor* | 2 | 2.3 |
| *Catunaregam spinosa* | 1 | 1.2 |
| *Combretum molle* | 11 | 12.8 |
| *Dalechampia capensis* | 1 | 1.2 |
| *Dialium schlechteri* | 3 | 3.5 |
| *Dichrostachys cinerea* | 1 | 1.2 |
| *Erythroxylum delagoense* | 1 | 1.2 |
| *Euclea natalensis* | 1 | 1.2 |
| *Grewia caffra* | 3 | 3.5 |
| *Landolphia kirkii* | 2 | 2.3 |
| *Margaritaria discoidea* | 1 | 1.2 |
| *Maytenus senegalensis* | 1 | 1.2 |
| *Mundulea sericea* | 1 | 1.2 |
| *Peltophorum africanum* | 1 | 1.2 |
| *Plectroniella armata* | 1 | 1.2 |
| *Psydrax locuples* | 1 | 1.2 |
| *Rhoicissus digitata* | 1 | 1.2 |
| *Sapium integerrimum* | 1 | 1.2 |
| *Sclerocarya birrea* | 1 | 1.2 |
| *Spirostachys africana* | 5 | 5.8 |
| *Strychnos madagascariensis* | 18 | 20.9 |
| *Strychnos spinosa* | 10 | 11.6 |
| *Tabernaemontana elegans* | 1 | 1.2 |

| **Table 12** *continue* | | |
|---|---|---|
| *Terminalia sericea* | 3 | 3.5 |
| *Vanqueria infausta* | 1 | 1.2 |
| *Zanthoxylum leprieurii* | 1 | 1.2 |
| *Ziziphus mucronata* | 1 | 1.2 |

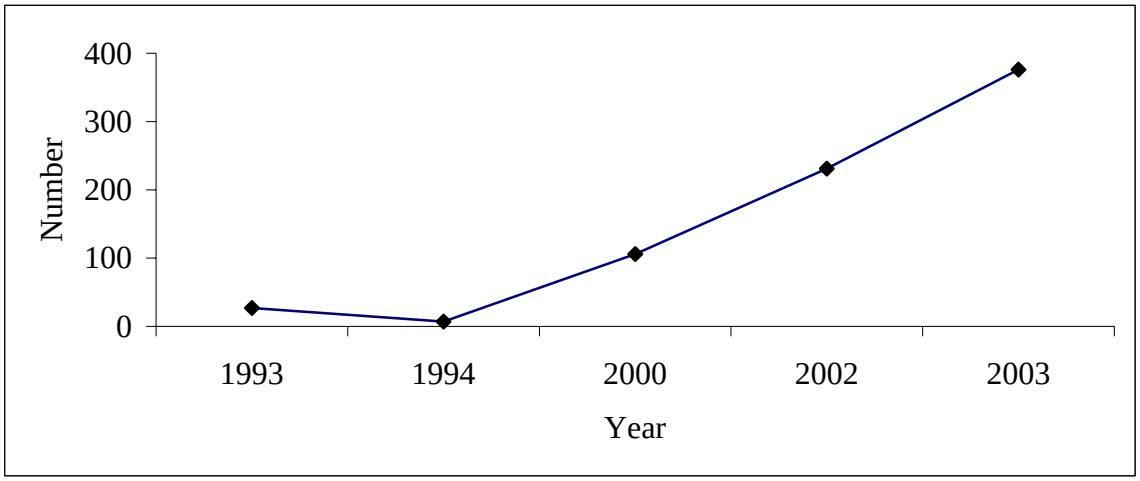


**Figure 15:** Aerial survey of the greater kudu as based on total counts conducted in Tembe Elephant Park, South Africa from 1993 to 2003. Source: Matthews *et al*. (2004).

# DISCUSSION

## Habitat preference

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

The Closed Woodland on clay occurs on clay-rich duplex soils that are normally associated with the bottomlands of the dunes and the edges of the Muzi Swamp. Perennial pans were also found throughout this vegetation type. The structure of the Closed Woodland on clay varied from areas of dense vegetation to thickets associated with termitaria (Matthews *et al*. 2001). Although this vegetation type only covered 2.5% of the surface area of Tembe, 9.2% of observations of the greater kudu were made there.

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 most abundant woody plant used by the greater kudu), *Combretum molle* (the second most abundant woody plant used by the greater kudu), and *Terminalia sericea* (Matthews *et al*. 2001). The highest occurrence of the greater kudu (43.9% of all observations) was in this vegetation type. The presence of dense vegetation and thickets offering protection and food in the Closed Woodland on clay, and thepresence of preferred food plants in the Open Woodland was most likely the reason why the greater kudu preferred these vegetation types for use in Tembe.

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. The Muzi Swamp comprised of reed beds of the extensive Muzi Swamp system that crosses the eastern side of Tembe and extends northwards to Maputo Bay in Mozambique. The Muzi Swamp was the only natural source of permanent water present

in Tembe throughout the year (Matthews *et al*. 2001). The fact that the greater kudu is dependent on water and requires a permanent source of surface water within its range was most likely the reason for it using these vegetation types (Bothma *et al*. 2002).

The Closed Woodland/Thicket Mosaic on sand occurs on the dune crests, slopes and interdune depressions throughout Tembe and could 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 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 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. Although not preferred for use in Tembe, these vegetation types were used in proportion to their availability in Tembe and seem to be suitable to sustain the greater kudu.

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 few to no trees and shrubs. It gradually acquires a more open woodland character further away from the Sand Forest. The second highest occurrence of the greater kudu (29.3% of all observations) was in this vegetation type. Although the greater kudu was often observed in the Sand Forest/Grassland Mosaic during field observations, the overall density of the greater kudu there was low because of the size of this vegetation type, and it was used by the greater kudu in the same ratio as its proportional occurrence in Tembe. The greater kudu generally does not occur in forest or open grassland areas and this is most likely also the reason why the Sand Forest/Grassland Mosaic was not used often in Tembe by it, and why it was never recorded in the Hygrophilous Grassland or in the Old Lands (Skinner & Smithers 1990). Vegetation types with an intermediate density that provide protection, preferred food plants and surface water nearby was consistently selected for use by the greater kudu over dense vegetation or vegetation with an open grassland structure.

**Population status**

The population of the greater kudu in Tembe is currently estimated at 780 individuals. The greater kudu is one of the most resilient larger mammal species in South Africa and

persists even under heavy hunting pressure and settlement (Skinner & Smithers 1990). It is currently listed as Least Concern in the South African Red Data Book, implying that it is widespread and abundant in South Africa, and there is evidence that the population is increasing (Friedmann & Daly 2004). Population trends in Tembe indicate an increase in the number of individuals from 1993 to 2003, with an annual rate of increase of 28% from 2002 to 2003 (Matthews 2004). The natural population increase for the greater kudu can be about 20 to 30% per year (Bothma *et al*. 2002). There is at present no immediate threat of a decline for the population in Tembe.

The greater kudu has a low natural density and in savanna areas the stocking density is approximately 1 greater kudu per 40 ha (Bothma *et al*. 2002). According to Bothma *et al.* (2002), in areas with a higher woody plant density like the Valley Bushveld or Succulent Thicket of the Eastern Cape province in South Africa, the density of the greater kudu is also much higher. In these areas the density of the greater kudu can be up to 1 greater kudu per 6.3 ha. In Tembe, 10 020 ha of preferred habitat (vegetation types 3 and 7) and 7190 ha of habitat that is used in proportion to its availability (vegetation types 1, 2, 5 and 9) are available, giving 17 210 ha of suitable habitat. The woody plant density in Tembe is much higher than in other savanna areas, although not as dense as in the Eastern Cape. The stocking density in Tembe is estimated to be around 1 greater kudu per 20 ha. This equates to an estimated maximum recommended stocking density of 861 greater kudu based on habitat availability. In other areas, the greater kudu is mostly exposed to a shortage of browse during the late dry season and it is important to monitor the condition of the animals in Tembe during this time to determine whether the current stocking density of the greater kudu is satisfactory. In order to keep the greater kudu population in Tembe at its current level, 156 to 234 individuals will have to be removed annually based on an expected population growth rate of 20 to 30%, whether this is through predation, culling, live capture for translocation or other causes (Bothma *et al*. 2002).

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