CHAPTER 9

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

INTRODUCTION

The red duiker is a member of the family Bovidae and the tribe Cephalophini (Grubb 1993). This tribe includes small to medium-sized, cover-dependent antelope showing little sexual dimorphism (Estes 1997). The colloquial name comes from the rich red-coloured pelage of representatives of the species from KwaZulu-Natal, South Africa. Smith first described it scientifically in 1834 (Skinner & Smithers 1990). Most duikers live in forests, although some have adapted to more open, swampy or mountainous areas (Kingdon 1997). Duikers are exclusive to Africa and today virtually every indigenous African forest and woodland is occupied by at least one species of duiker (Estes 1997; Kingdon 1997). The red duiker is associated with indigenous forests, forest clumps and dense thickets (Mills & Hes 1997). All the cephalophines are classified as frugivores, being animals with a diet consisting of > 70% fruits and little or no monocotylodons (Gagnon & Chew 2000).

In distribution, the red duiker is confined to the indigenous forests along the east coast of Africa (Mills & Hes 1997). In southern Africa the red duiker occurs naturally in eastern Mozambique, the Lebombo Mountains in Swaziland, in indigenous forests in the KwaZulu-Natal province, and isolated populations on the escarpment of the Mpumalanga province of South Africa (Mills & Hes 1997). The red duiker is still widespread and common, although rarely seen over most of its range despite intensive hunting and trapping for the bush meat trade (Kingdon 1997). Although the red duiker used to be classified as Rare in the South African Red Data Book (Smithers 1986), it is currently classified as being of Least Concern, implying that the species is widespread and abundant (Friedmann & Daly 2004). There is, however, debate about this classification as there has been a considerable decrease in the population of the red duiker since the last assessment in 1986. The red duiker could possibly be elevated to the Near Threatened category based on the fact that there are fewer than 10 000 mature individuals left in the South African population, which is restricted to only four locations (Friedmann & Daly 2004).

Knowledge of the habitat preference, ecological requirements 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). In conservation areas, one of the primary objectives is to maintain viable populations of all the animal species present. The fact that most species are linked to major vegetation types help in understanding their distribution patterns (Pienaar 1974).

In the present study, we tested the hypothesis that the red duiker responded to the variables in its physical habitat in proportion to its availability within the Tembe Elephant Park. If the red duiker showed a preference of use for certain vegetation types, then the suitability of different areas can be determined for the red duiker 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 red duiker. The objective of the present study was therefore to gather information on the habitat preference and conservation status of the red duiker within the park. This information is crucial for the effective management of the population within the park and 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 red duiker 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 red duiker 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 red duiker 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 red duiker 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 red duiker 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 red duiker 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 red duiker in Tembe and to calculate trends in the population from 1993 to 2003 (Matthews 2004).

RESULTS

Habitat preference

In all, 938 observations on the red duiker were recorded during the study period. It was most often found in the Sand Forest/Grassland Mosaic (31.9% of observations) and Open Woodland (30.4%), less often in the Closed Woodland/Thicket Mosaic on sand (19.3%) and Closed Woodland on clay (14.2%), and least often in the *Acacia borleae* Shrubland/Bush Clump Mosaic on clay (2.9%) and Sparse Woodland (1.4%). The red duiker was never found in the Hygrophilous Grassland, Muzi Swamp or Old Lands (Table 13). The Chi-square goodness-of-fit test for the overall data set showed a significant difference (χ^2= 73.868; $p \leq 0.05$; df = 8) in use versus availability for the different vegetation types in Tembe. The preference index of use of vegetation types by the red duiker 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 used and vegetation type 7 as being used in the same ratio as its proportional occurrence (Table 14).

Based on 37 feeding observations, 28 plant species were utilised by the red duiker in Tembe (Table 15). Generally, the fallen leaves, fruit and new shoots of the food plants were consumed. The browsing height was predominantly from 100 to 300 mm above the ground. Using the number of times that a red duiker was observed feeding on a particular species as a measure of the frequency of consumption,

Table 13. Vegetation types in Tembe Elephant Park, South Africa, their respective sizes (km²), proportion of the available habitat, proportion of use by the red duiker and preference index of use by the red duiker 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	2.9	0.759
2	Closed Woodland/Thicket Mosaic on sand	51.8	15.0	19.3	0.223
3	Closed Woodland on clay	8.7	2.5	14.2	0.824
4	Hygrophilous Grassland	6.7	2.0	0.0	-1.000
5	Muzi Swamp	3.4	1.0	0.0	-1.100
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	31.8	-0.336
9	Sparse Woodland	14.4	4.2	1.4	-0.667

Table 14. The preference of use of the vegetation types in Tembe Elephant Park, South Africa by the red duiker 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	6.9	$0.014 \leq p_1 \leq 0.044$	Prefer
2	15	1.2	$0.158 \leq p_2 \leq 0.228$	Prefer
3	2.5	54.8	$0.111 \leq p_3 \leq 0.173$	Prefer
4	2.0	2.0	$0.000 \leq p_4 \leq 0.000$	Not used
5	1.0	1.0	$0.000 \leq p_5 \leq 0.000$	Not used
6	0.2	0.2	$0.000 \leq p_6 \leq 0.000$	Not used
7	26.6	0.5	$0.263 \leq p_7 \leq 0.345$	No pattern
8	47.8	5.4	$0.276 \leq p_8 \leq 0.360$	Not used
9	4.2	1.9	$0.003 \leq p_9 \leq 0.025$	Not used
Total	100	73.9	-	-

*Vegetation type numbers corresponds with Figure 5 in chapter 2, and Table 13.

Table 15. The percentage occurrence of various plant species in the diet of the red duiker based on 37 feeding observations from December 2002 to November 2003 in Tembe Elephant Park, South Africa.

Plant species	Actual observations	Percentage of occurrence
Acacia burkei	2	5.4
Afzelia quanzensis	3	8.1
Boscia foetida	1	2.7
Bridelia cathartica	1	2.7
Carissa tetramera	2	5.4
Combretum molle	1	2.7
Coddia rudis	1	2.7
Croton gratissimus	1	2.7
Deinbollia oblongifolia	1	2.7
Dichrostachys cinerea	1	2.7
Euclea natalensis	1	2.7
Gardenia volkensii	1	2.7
Grewia caffra	1	2.7
Grewia microthyrsa	1	2.7
Gymnosporia senegalensis	1	2.7
Hymenocardia ulmoides	1	2.7
Londolphia kirkii	2	5.4
Margaritaria discoidea	1	2.7
Ochna barbosae	1	2.7
Plumbago zeylanica	1	2.7
Pteleopsis myrtifolia	2	5.4
Rhus gueinzii	1	2.7
Salacia leptoclada	1	2.7
Strychnos madagascariensis	2	5.4
Strychnos spinosa	3	8.1
Tabernaemontana elegans	1	2.7
Terminalia sericea	1	2.7
Uvaria caffra	1	2.7

Afzelia quanzensis (8.1%) and *Strychnos spinosa* (8.1%) were the most commonly eaten plants (Table 15). During field observations the red duiker was often observed feeding underneath these and other large trees.

Population status

During the total area aerial count, 191 red duiker were recorded in 182 groups. Based on the distance sample estimate this indicated a population of 714 individuals, which is the current estimate for the red duiker population in Tembe (Matthews 2004). Population trends appear to indicate an increase in the population of red duiker from a total area aerial count of 54 individuals in 1993 to the 191 in 2003 (Figure 16).

DISCUSSION

Habitat preference

The red duiker 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 red duiker were ever recorded in the Hygrophilous Grassland, Muzi Swamp or Old Lands and these vegetation types were clearly not being used. The Sand Forest/Grassland Mosaic and the Sparse Woodland were also not being used often, and the Open Woodland was used in proportion to its availability.

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 (Matthews *et al*. 2001). Of all the observations of the red duiker, only 2.9% were in this vegetation type that 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 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. Of all the observations of the red duiker, 19.3% were in this vegetation type.

The Closed Woodland on clay occurs on clay-rich duplex 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, 14.2% of the observations of the red duiker were made there. The presence of dense vegetation

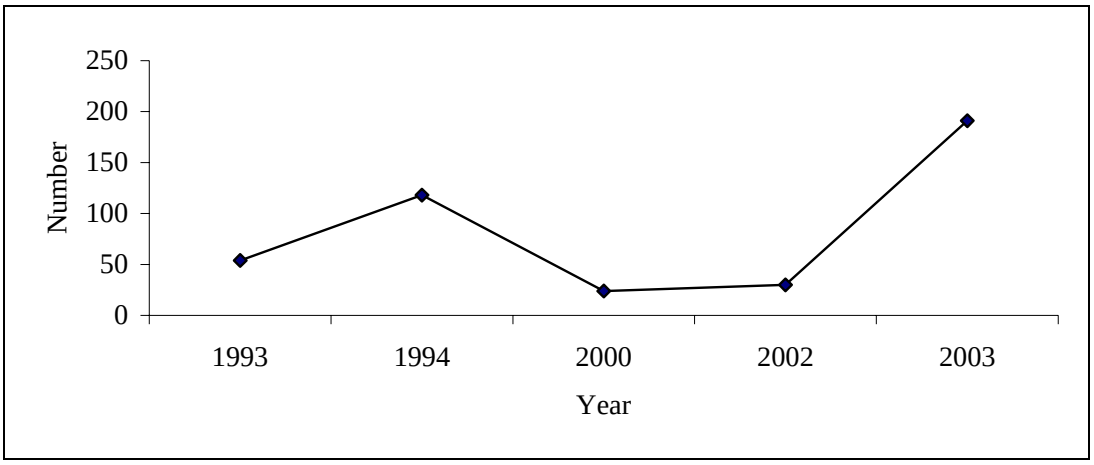

Figure 16: Aerial survey of the red duiker as based on total counts conducted in Tembe Elephant Park, South Africa from 1993 to 2003. Source: Matthews *et al*. (2004).

or thickets seemed to play an important role in the distribution of the red duiker and its preference towards certain vegetation types in Tembe.

Structurally, the Hygrophilous Grassland was classified as open grassland with scattered woody shrubs that occurs adjacent to the Muzi Swamp and around marshy areas associated with sand. 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 (Matthews *et al*. 2001). The open nature of the Hygrophilous Grassland, Muzi Swamp and Old Lands were most likely the reason why the red duiker did not use these vegetation types in Tembe.

Even though the red duiker was often recorded in the Sand Forest/Grassland Mosaic and Sparse Woodland, no preference of use was shown towards these vegetation types. The Sand Forest/Grassland Mosaic was the largest vegetation type in Tembe and was mostly associated with dunes (Matthews *et al*. 2001). Although this vegetation type had the highest occurrence of red duiker in Tembe (31.9%), the overall density of the red duiker was low because of the size of this vegetation type. The Sand Forest/Grassland Mosaic was structurally classified as forest, interspersed with grassland. The Sparse Woodland mainly occurs on flat areas between dunes, but also to a lesser degree on dune slopes and crests throughout Tembe. This vegetation type was a grassland characterised by an abundance of shrub species. It produces annual leafy and flowering shoots from a perennial, underground woody rootstock. The lack of sufficient cover also seemed to limit the use of the Sparse Woodland by the red duiker in Tembe.

The Open Woodland was the second largest vegetation type in Tembe and occurs on dune crests, slopes and interdune depressions throughout the park. Although the red duiker reached its second highest occurrence (30.4%) in this vegetation type, it was used 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. All the cephalophines have diets that include a large amount of fruits and little or no monocots (Gagnon & Chew 2000). According to Bowland (1997) the red duiker feeds on leaves, flowers and fruit freshly fallen from forest canopy trees, and it seldom actively browses live plant material. In Tembe, however, it was often observed browsing on the new leaves and shoots of small shrubs. The red duiker will venture beyond forest margins to forage, but retreats to cover at the slightest disturbance. Dense vegetation types with thickets and interspersed

perennial pans on clay-rich soils were consistently selected for use over vegetation types with an open structure and a well-developed grass layer on more sandy soils.

Population status

The population of the red duiker in Tembe is currently estimated at 714 individuals, which is most likely an underestimate because of the counting technique used (Matthews *et al*. 2001). There is no single comprehensive counting technique that is suitable for counting all animal species. Knowledge of the habitat requirements of the animals to be counted is essential before any count should be attempted (Bothma 2002). As a result of the behavioural response of the red duiker to flee more readily when disturbed, drive counts proved to be a reliable counting technique in other areas (Bowland 1990). The nature of the vegetation in Tembe, as well as the presence of dangerous wildlife, however, limits the use of this technique within the park. It is recommended that road strip counts be used to supplement the aerial counts for the red duiker in Tembe in order to get a more reliable estimate of its conservation status. Population trends do, however, appear to indicate an increase in the number of individuals from 1993 to 2003 and there is at present no threat of a decline for the red duiker population in Tembe.

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