CHAPTER 7

HABITAT PREFERENCE AND STATUS OF BURCHELL'S ZEBRA IN TEMBE ELEPHANT PARK, SOUTH AFRICA

INTRODUCTION

Burchell's zebra is a member of the family Equidae comprising large, single-hoofed ungulates that are built for speed and long-distance movements (Estes 1997). The name zebra is derived from the Italian/Portuguese form of the name that was given to a group of species in the Democratic Republic of the Congo (Skinner & Smithers 1990; Fürstenburg 2002). Gray first described it scientifically in 1824, based on a skin obtained by Burchell in the Kuruman district of the Northern Cape, South Africa (Grubb 1999). Burchell's zebra is one of Africa's most adaptable and successful grazers, utilising a broad range of savanna habitats. It is equipped to deal both with tall, tough grass stems and the early stages of grass growth after the rains. Burchell's zebra is totally dependent on frequent water drinking (Kingdon 1997) and is among the most water-dependent of the plains wildlife (Estes 1997). Burchell's zebra is seldom found more than 10 to 12 km from water, and it moves daily between its preferred grazing and water supplies. Being gregarious, Burchell's zebra either lives in small family groups consisting of a stallion and one or more mares and their foals, or in bachelor herds (Skinner & Smithers 1990).

Modern horses and zebras developed in North America and colonised Eurasia and Africa during the last 3 million years (Kingdon 1997). Four of the six wild *Equus* species are today confined to Africa, including three zebra species, *Equus burchellii* (Burchell's zebra); *Equus zebra* (Mountain zebra); *Equus grevyi* (Grevy's zebra) as well as the African wild ass *Equus africanus* (Grubb 1993; Estes 1997; Fürstenburg 2002). Burchell's zebra was formerly distributed from the Orange River northwards through the Limpopo and Mpumalanga provinces of South Africa, the northern parts of Botswana and Namibia northwards and eastwards, and the northern parts of the KwaZulu-Natal province of South Africa. Naturally occurring populations in South Africa are today confined to conserved areas in the northern parts of the KwaZulu-Natal province, and the Mpumalanga and Limpopo provinces. Although Burchell's zebra has been introduced into private nature reserves and wildlife ranches throughout the country (Mills & Hes 1997), the extent and status of the global population is still unknown. There is, furthermore, some debate over the taxonomic clarification of the subspecies distinctions in southern Africa (Friedmann & Daly 2004). It is suggested by some authors that the population occurring in the

northern KwaZulu-Natal province in South Africa and northwards might be a separate subspecies of the Burchell's zebra, possibly *Equus burchellii selousi* (Kingdon 1997).

Three of the four indigenous African equids are rare or restricted in distribution, while the Burchell's zebra rivals the horse as the most successful member of the family (Estes 1997). Although Burchell's zebra is still by far the most abundant and widespread of all the African equids, several subspecies occur at low population levels and several are declining (Stuart & Stuart 1996). Given the uncertain future of small, isolated populations of Burchell's zebra, some subspecies may well become vulnerable or endangered in the near future (Kingdon 1997). While the cause of the decline of Burchell's zebra is not known, its incompatibility with modern agriculture and ranching has led to its widespread extermination outside formally protected areas (Kingdon 1997).

Knowledge of the habitat preference, ecological requirements and conservation status of large herbivores is basic to any management programme for a reserve, and is 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). 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 Burchell's zebra responded to the variables in its physical habitat in proportion to its availability within the Tembe Elephant Park. If the Burchell's zebra showed a preference of use for certain vegetation types, then the suitability of different areas could be determined for it by evaluating the biophysical characteristics of the preferred vegetation types. More accurate stocking densities could then also be calculated according to the habitat preferences and diet of the Burchell's zebra. The primary objective of the present study was therefore to gather information on the habitat preference and conservation status of the Burchell's zebra within the park. This information is crucial for the effective management of the population of Burchell's zebra in the park, as well as for 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 Burchell's zebra 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 Burchell's zebra 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 Burchell's zebra 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 Burchell's zebra recorded in each vegetation type (Beyers *et al*. 1984; Allredge & Ratti 1992; Pienaar *et al*. 1992).

Population status

An aerial survey that was done in October 2003 was used to determine the current population status of Burchell's zebra 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 Burchell's zebra in Tembe and to calculate trends in the population from 1993 to 2003 (Matthews 2004).

RESULTS

Habitat preference

A total of 42 observations were recorded during the study period. Burchell's zebra was most often found in the Open Woodland (47.6% of all observations) and Sand Forest/Grassland Mosaic (33.3%), less often in the Hygrophilous Grassland (7.1%), Muzi Swamp (4.8%) and Sparse Woodland (4.8%), and least often in the Closed Woodland on clay (2.4%). Burchell's zebra was never recorded in *Acacia borleae* Shrubland/Bush Clump Mosaic on clay, Closed Woodland/Thicket Mosaic on sand or Old Lands (Table 8).

Table 8. Vegetation types in Tembe Elephant Park, South Africa, their respective sizes (km²), proportion of the available habitat, proportion of use by Burchell's zebra and preference index of use by Burchell's zebra 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	0.0	-1.000
2	Closed Woodland/Thicket Mosaic on sand	51.8	15.0	0.0	-1.000
3	Closed Woodland on clay	8.7	2.5	2.3	-0.080
4	Hygrophilous Grassland	6.7	2.0	7.1	0.718
5	Muzi Swamp	3.4	1.0	4.8	0.792
6	Old Lands	0.6	0.2	0.0	-1.000
7	Open Woodland	91.5	26.6	47.7	0.441
8	Sand Forest/Grassland Mosaic	164.8	47.8	33.3	-0.305
9	Sparse Woodland	14.4	4.2	4.8	0.125

The Chi-square goodness-of-fit test for the overall data set showed a significant difference (χ^2 = 64.582; $p \leq 0.05$; df = 8) in use versus availability for the different vegetation types in Tembe. The preference index of use of vegetation types by Burchell's zebra in Tembe indicated that vegetation types 1, 2 and 6 were not being used and that vegetation types 3, 4, 5, 7, 8 and 9 were being used in the same ratio as their proportional occurrence (Table 9).

Population status

During the total aerial count, 170 Burchell's zebra were recorded in 39 groups. Based on the distance sample estimate, this indicated a population of 492 individuals. However, due to the small sample size, this estimate was not considered to be reliable and the Burchell's zebra population in Tembe is currently estimated at 200 individuals (Matthews 2004). This current estimate of the population is, however, still higher than the previous estimates and the population of Burchell's zebra appears to be increasing from a total aerial count of 51 individuals in 1993 to the 170 in 2003 (Figure 14).

DISCUSSION

Habitat preference

No observation of the Burchell's zebra was recorded in the *Acacia borleae* Shrubland/Bush Clump Mosaic on clay, the Closed Woodland/Thicket Mosaic on sand or the Old Lands, and it was clearly not using these vegetation types. The Closed Woodland on clay, Hygrophilous Grassland, Muzi Swamp, Open Woodland, Sand Forest/Grassland Mosaic and Sparse Woodland were all used in proportion to their availability within the park. 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 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 varied from closed to semi-closed crown gaps and a canopy that approximately varied from 8 to 12 m in height (Matthews *et al*. 2001). In general, Burchell's zebra was partial to open areas, avoiding areas of dense woodland except when moving through them (Skinner & Smithers 1990).

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

Vegetation type number*	Percentage of habitat	Chi-square contribution	Confidence interval	Habitat use
1	0.7	0.7	$0.000 \leq p_1 \leq 0.000$	Not used
2	15	15.0	$0.000 \leq p_2 \leq 0.000$	Not used
3	2.5	0.0	$-0.041 \leq p_3 \leq 0.087$	No pattern
4	2.0	13.0	$-0.038 \leq p_4 \leq 0.180$	No pattern
5	1.0	14.4	$-0.043 \leq p_5 \leq 0.139$	No pattern
6	0.2	0.2	$0.000 \leq p_6 \leq 0.000$	Not used
7	26.6	16.7	$0.264 \leq p_7 \leq 0.688$	No pattern
8	47.8	4.4	$0.133 \leq p_8 \leq 0.533$	No pattern
9	4.2	0.1	$-0.043 \leq p_9 \leq 0.139$	No pattern
Total	100	64.5	-	-

*Vegetation type numbers corresponds with Figure 5 in chapter 2, and Table 8.

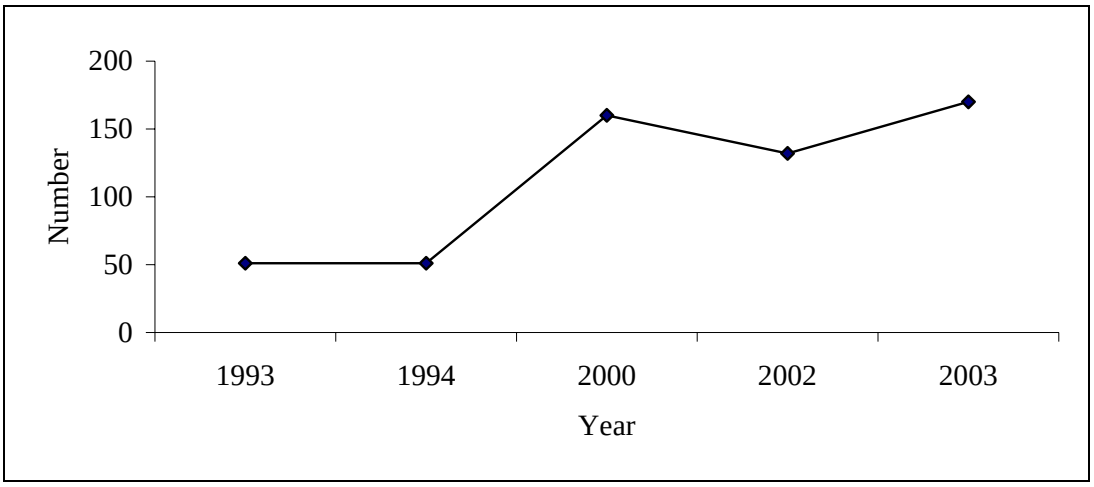

Figure 14: Aerial survey of the Burchell's zebra as based on total counts conducted in Tembe Elephant Park, South Africa from 1993 to 2003. Source: Matthews *et al*. (2004).

The dense nature of large areas of the *Acacia borleae* Shrubland/Bush Clump Mosaic on clay and Closed Woodland/Thicket Mosaic on sand were therefore probably the reason why these vegetation types were not being used by the Burchell's zebra in Tembe.

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 and it had few grass species.

Both the Hygrophilous Grassland and the Muzi Swamp had a grassland structure with only scattered trees or thickets. The Muzi Swamp consists of reed beds in an extensive swamp system that crosses the eastern side of Tembe and extends northwards to Maputo Bay in Mozambique. Abundant plant species in the Hygrophilous Grassland were the grasses *Imperata cylindrica, Eragrostis lappula, Dactyloctenium geminatum, Panicum genuflexum* and *Eragrostis heteromera* and the shrub *Acacia nilotica* (Matthews *et al*. 2001). None of these grass species present has a high grazing value and therefore the grasses are generally poorly utilised by grazers (Van Oudtshoorn 1999). Burchell's zebra is dependent on frequent drinking of water (Skinner & Smithers 1990; Estes 1997; Kingdon 1997; Fürstenburg 2002) and the presence of water in the Closed Woodland on clay, Hygrophilous Grassland and Muzi Swamp most likely promoted the use of these vegetation types in Tembe. The Muzi Swamp was the only natural source of permanent water present in Tembe throughout the year (Matthews *et al*. 2001).

The Open Woodland was the second largest vegetation type in Tembe and occurs on dune crests, slopes and interdune depressions throughout the park (Matthews *et al*. 2001). This vegetation type was characterised by a good grassy layer interspersed with a few tall trees of approximately 8 to 10 m in height. Grass species abundant in this vegetation type included several species with high grazing values such as *Andropogon gayanus*, *Panicum maximum* and *Digitaria eriantha* (Van Oudtshoorn 1999; Matthews *et al*. 2001). During field observations, Burchell's zebra was often observed feeding in the Open Woodland and it also reached its highest density in this vegetation type (47.6% of all observations).

Although the Sand Forest/Grassland Mosaic had the second highest density (33.3%) of Burchell's zebra in Tembe, it was the largest vegetation type present, causing the overall density of Burchell's zebra in it to be low. The Sand Forest/Grassland Mosaic was mostly associated with dune crests and slopes, but also some interdune depressions, and was structurally classified as a forest, interspersed with grassland (Matthews *et al*. 2001). The grassland there was open

with few to no trees and shrubs. Abundant grass species included species with a low grazing value like *Andropogon chinensis*, *Perotis patens*, *Diheteropogon amplectens* and *Aristida stipitata* subsp. s*picata*. In areas where the percentage of sand in the soils was lower, stands of *Digitaria eriantha* with a high grazing value could be found (Van der Walt 2004). These grasslands gradually acquired a more open woodland character the further away it was from the Sand Forest (Matthews *et al* 2001). During field observations, Burchell's zebra was observed feeding on the grassland areas in this vegetation type, but it seldom entered the Sand Forest. It also used the game trails present in the Sand Forest with hesitation.

The Sparse Woodland was mainly found on flat areas between the dunes, but also to a lesser degree on the dune slopes and crests throughout the park. It was a type of grassland that was characterised by an abundance of shrub species that produced annual leafy and flowering shoots from a perennial, underground woody rootstock. The grass layer was characterised by a large variety of species (Matthews *et al*. 2001). Only 4.8% of observations of Burchell's zebra were in this vegetation type, but it also only covered 4.2% of the surface area of the study area.

The habitat of ungulates provides them with food, water and cover and the feeding styles of each species are therefore of primary importance in determining their preferred habitat. Generally, Burchell's zebra is not selective towards grass species, but rather to grass height when feeding and all the green parts of a grass plant up to 150 mm in height, regardless of species, are usually eaten (Fürstenburg 2002). Although no vegetation type in Tembe was preferred for use by Burchell's zebra, the Open Woodland, Sand Forest/Grassland Mosaic and Sparse Woodland seemed suitable to sustain them there. Vegetation types with an open structure and a well-developed grass layer on more sandy soils were consistently selected for use over dense vegetation types with thickets on clay-rich soils.

Population status

The population of Burchell's zebra in Tembe is currently estimated at 200 individuals, although the reliability of this estimate was questionable. The mean size of the family groups of Burchell's zebra generally varies within conservation areas and it appears to be correlated with the condition of the habitat and the predation levels (Skinner & Smithers 1990). In optimal habitat, a maximum of 0.04 zebras/ha should, however, be stocked according to Fürstenburg (2002). In Tembe, 27 072 ha of suitable habitat (vegetation types 7, 8 and 9) are available, although only the grassland of the Sand Forest/Grassland Mosaic are currently being utilised by the zebra. By excluding the Sand Forest/Grassland Mosaic from the calculation, 10 589 ha of suitable habitat

(vegetation types 7 and 9) are available. This translates into an estimated maximum recommended stocking rate of 424 Burchell's zebra in Tembe, based on habitat availability. The current estimated population of 200 individuals therefore constitute approximately half of the maximum recommended stocking rate.

As wildlife populations increase, it becomes necessary to set limits to their population size in order to keep them in balance with their food resources and to provide for their social needs (Bothma *et al*. 2004). Breeding in the Burchell's zebra is not seasonal and foals may be born at any time of the year. There does, however, appear to be a breeding peak from December to January, and 85% of the foals are usually born from October to March (Skinner & Smithers 1990; Fürstenburg 2002). The population growth rate, and therefore the number of animals that can be harvested annually, fluctuates from 15 to 29%, depending on the environmental conditions, predation pressure and social interactions in a given habitat (Fürstenburg 2002). In order to keep the Burchell's zebra population in Tembe at its current size, 30 to 58 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 means. This is, however, not recommended before reliable estimates of the population size and its annual growth rate in Tembe have been obtained. Until then it is recommended to monitor the Burchell's zebra population in Tembe and to leave the population to increase naturally until it approaches the estimated maximum recommended population of 424 individuals.

REFERENCES

ALLREDGE, J.R. & RATTI, J.T. 1992. Further comparison of some statistical techniques for analysis of resource selection. *Journal of Wildlife Management* 56: 1-9.

BEYERS, G.R., STEINHORST, R.K. & KRAUSMAN, P.R. 1984. Clarification of a technique for analysis of utilization-availability data. *Journal of Wildlife Management* 48: 1050-1053.

BOTHMA, J. du P., VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Using diet and plant resources to set wildlife stocking densities in African savannas. *Wildlife Society Bulletin.* 32: 840-851.

DEKKER, B., VAN ROOYEN, N. & BOTHMA, J. du P. 1996. Habitat partitioning by ungulates on a game ranch in the Mopani veld. *South African Journal of Wildlife Research* 26: 117-122.

ESTES, R.D. 1997. *The Behavior Guide to African Mammals.* Russel Friedman Books, Halfway House.

FRIEDMANN, Y. & DALY, B. (Eds) 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

FÜRSTENBURG, D. 2002. Bontsebra "Burchell's zebra" (*Equus burchelli antiquorum*). *Game and Hunt* 8: 8-9, 43.

GAUGRIS, J.Y., MATTHEWS, W.S., VAN ROOYEN, M.W. & BOTHMA, J. du P. 2004. The vegetation of Tshanini Game Reserve and a comparison with equivalent units in the Tembe Elephant Park in Maputaland, South Africa. *Koedoe* 47: 9-29.

GRUBB, P. 1993. Order Perissodactyla. In: D.E. Wilson & D.M. Reeder (Eds), Mammal Species of the World: A Taxonomic and Geographic Reference, Second edition (pp. 369-370). Smithsonian Institution Press, Washington DC.

GRUBB, P. 1999. Types and type localities of ungulates named from southern Africa. *Koedoe* 42: 13-45.

JACOBS, J. 1974. Quantitative measurement of food selection. *Oecologia* 14: 413-417.

KINGDON, J. 1997. The Kingdon Field Guide to African Mammals. Academic Press, San Diego.

MATTHEWS, W.S. 2004. Large herbivore population estimates for Tembe Elephant Park: October 2003. Unpublished report, KwaZulu-Natal Nature Conservation Services.

MATTHEWS, W.S., VAN WYK, A.E., VAN ROOYEN, N. & BOTHA, G.A. 2001.Vegetation of the Tembe Elephant Park, Maputaland, South Africa. *South African Journal of Botany* 67: 573-594.

MILLS, G. & HES, L. 1997. The Complete Book of Southern African Mammals. Struik Winchester, Cape Town.

PIENAAR, D.J., BOTHMA, J. du P. & THERON, G.K.1992. Landscape preference of the white rhinoceros in the southern Kruger National Park. *Koedoe* 35: 1-7.

PIENAAR, U. de V. 1974. Habitat-preference in South African antelope species and its significance in natural and artificial distribution patterns. *Koedoe* 17: 185-195.

SKINNER, J.D. & SMITHERS, R.H.N. 1990. The Mammals of the Southern African Subregion. University of Pretoria, South Africa.

STUART, C. & STUART, T. 1996. Africa's Vanishing Wildlife. Southern Book Publishers, Halfway House.

TAINTON, N. M. 1999. Veld Management in South Africa. University of Natal Press, Pietermaritzburg.

VAN DER WALT, P. 2004. Sandwoud. *Game and Hunt* 10: 14-16.

VAN OUDTSHOORN, F. 1999. Guide to Grasses of Southern Africa. Briza Publications, Pretoria.

VAN ROOYEN, N., BREDENKAMP, G.J. & THERON, G.K. 1996. Veld management. In: J. du P. Bothma (Ed.), Game Ranch Management, Third edition (pp 539-572). Van Schaik, Pretoria.