Cheetahs of the Kruger Park

TONY BOWLAND

Southern Africa is one of the few remaining strongholds of the cheetah, *Acinonyx jubatus*, as it is extinct or occurs in very low densities throughout most of its former range, which extended through Africa and Asia to the Soviet Union (Skinner & Smi-thers, 1990). In Namibia and Zimbabwe, on the other hand, the absence of other large predators, such as lion, *Panthera leo*, and spotted hyaena, *Crocuta crocuta*, on farmland has allowed cheetah numbers to expand to levels where they have become problem animals in terms of domestic stock predation (Morsbach,1988). Thus the cheetah's existence outside proclaimed land is uncertain, which makes these areas vitally important for their conservation.

The Kruger National Park is large enough to accommodate a substantial cheetah population. Researchers on the cheetah project needed to measure the size of the population and identify factors which may be limiting. Knowledge regarding life history parameters of the Kruger National Park's cheetah population was relatively sparse, so within the ambit of a wider predator-prey study under the leadership of Dr Gus Mills, Specialist Scientist of the Kruger National Park, a project was set up to investigate the demography and behaviour of cheetahs. To simplify the analysis of data obtained in this study, the study area (the entire Kruger Park) was divided into four regions: southern, central, northern and far northern regions. The Sabie River, an effective barrier to cheetah, separated the southern and central regions, the Olifants River delineated the central and northern regions, and the Shingwedzi River demarcated northern and far northern regions.

The Kruger Park is large enough to accommodate a substantial cheetah population. Photo: Wayne Saunders/ABPL

To obtain information on cheetah numbers and distribution, a photographic competition, sponsored by the Endangered Wildlife Trust, was held in the Kruger National Park. In this article, Dr Tony Bowland, co-ordinator of the competition and cheetah researcher, brings readers up to date on the latest facts on the project.

The prime reasons for regional analysis were:

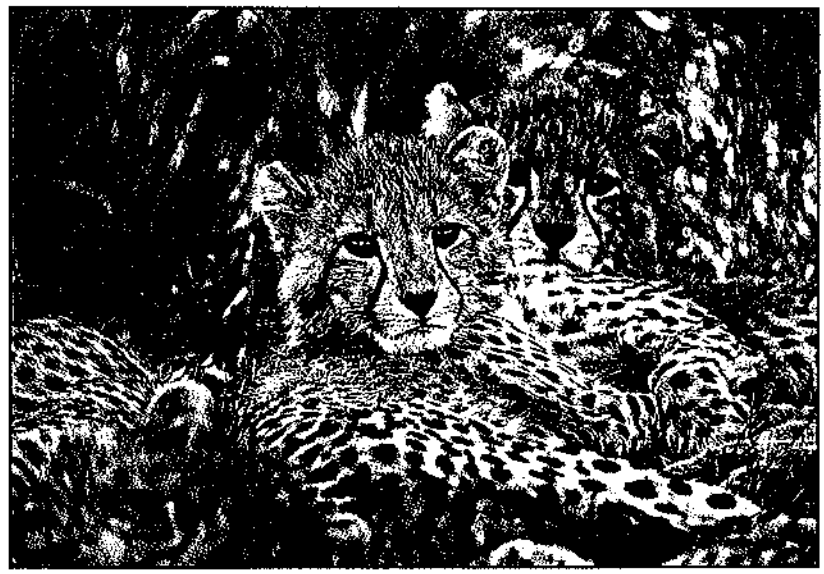
- to accommodate significantly different visitor densities in each region in processing raw data; and
- to facilitate the integration of data into the broader predator-prey project whose core study area was the southern region.

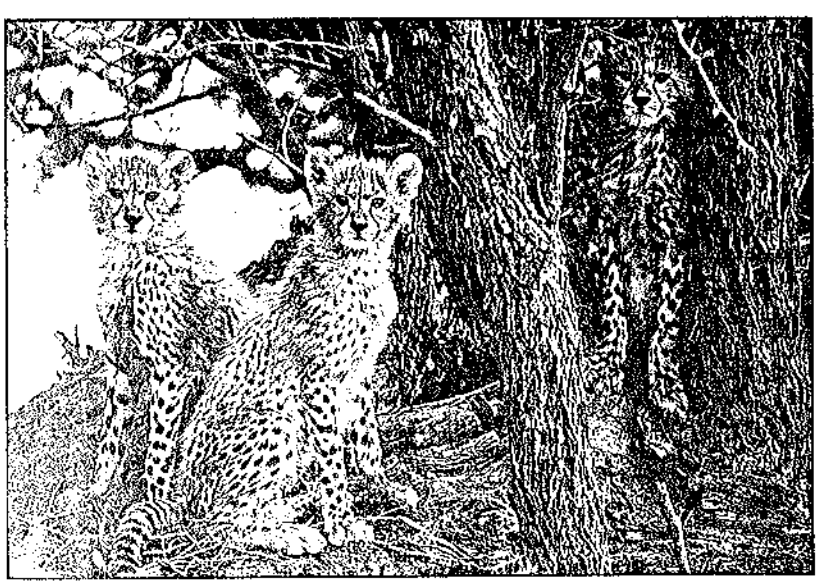
The effective conservation management of any species requires a reliable indication of population trends. Although wildlife managers have access to numerous density estimate techniques (Collinson, 1985), few of these techniques lend themselves to sampling a sparse and elusive population such as that of the cheetahs of the Kruger Park. Consequently, although they were considered rare, there was neither a recent, reliable estimate of numbers, nor much demographic information on cheetahs in the Kruger National Park. It was therefore imperative to examine alternative, reliable methods to investigate the population characteristics of cheetahs in the Kruger National Park.

Each cheetah has a unique spot pattern, and the potential to recognise individuals makes it possible to census the population (Eaton, 1968). However, since spot patterns require intensive examination and are usually not readily discernible in the field, it was necessary to

assemble a photographic reference collection of each member of the population. Such a comprehensive photographic reference collection not only permits a head count, but allows trends in demographic and environmental parameters of the cheetah population to be investigated. In order to compile a reference collection, a cheetah photographic competition, open to all Kruger Park visitors and staff, was launched in November 1990. It ran for 12 months. Large posters at entrance gates, camp reception offices and shops advertised the competition locally. Radio reports and popular wildlife magazines and journals advertised the cheetah project even more widely. Entry forms, placed at all gates and camps, requested information relevant to the project's objectives.

After six months, fewer than 50 entries had been received. This poor response to the competition suggested either visitor apathy or infrequent cheetah sightings. Consequently, a survey of cheetah sightings by visitors was conducted for 16 weeks during the dry season (May to October), when game viewing visibility is at its best. Questionnaires were placed, along with competition entry forms, at all gates and camps. These forms also requested visitors who had photographed cheetahs but had not entered the competition, to submit prints or negatives, in order to expand the reference collection and data base.





Above: Cheetah cubs. Below: A group of cheetahs in a tree. Photos: Roger de la Harpe/ABPL.

Kruger Park rangers diarise large carnivore observations made during their daily routine, and these observations are submitted in their annual reports. These reports were used to supplement cheetah information from areas where it was likely that visitor information was inadequate, such as the Stolsnek wilderness area and the northern region. The mean number of diarised cheetah sightings per ranger in each region was computed for three years so as to confirm regional trends in cheetah numbers determined from visitor information.

In the visitor survey between May and October, 2 783 cheetah sightings were reported, a weekly average of 122 (17 a day). Forty-one per cent of the respondents indicated that they had taken photographs, and half of them had intended entering the competition.

However, since only 18 per cent of the photographers submitted information, apathy rather than infrequent sightings explained the low competition entry rate.

Cheetah groups not recorded or recorded only once between October 1990 and November 1991 were excluded from the population census and demographic analysis shown in Table 1. Cheetah estimates disclosed a decline along the south-north gradient.

Demographic ratios showed significant differences between the cheetah populations of the central,

Table 1: Cheetah demographic patterns and density estimates in the Kruger National Park as at October 1991. (MS = solitary male; MC = male coalition; FS = solitary female; FC = female with cubs; SIB = sibling group. Value after code indicates number of males or cubs.)

		Southern	Central	Northern	Far Northern	Total
Adults						
Males	MS	7	3	2		12
	MC2	4	12	6	2	24
	MC3	9	12			21
	TOTAL	**20**	**27**	**8**	**2**	**57**
Females	FS	8	9	3	1	21
	FC1	1				1
	FC2	4	3	1		8
	FC3	2	1	1		4
	FC4	2	1			3
	FC5	1				1
	FC6	1				1
	TOTAL	**19**	**14**	**5**	**1**	**39**
Unsexed		**3**	**3**			**6**
Total adults		**42**	**44**	**13**	**3**	**102**
Subadults	SIB2			2		2
	SIB3	6	3	3		12
	SIB4			4		4
	TOTAL	**6**	**3**	**9**		**18**
Cubs	<6months	5		3		8
	6-12 months	13	6			19
	13-18 months	13	2	2		17
	>18 months	3	5			8
	TOTAL	**34**	**13**	**5**		**52**
Total: progeny		**40**	**16**	**14**		**70**
GRAND TOTAL		**82**	**60**	**27**	**3**	**172**
Density (km²/animal)		46,2	95,2	214,6		113,3
Estimates 1964 (Pienaar 1969)		90	110		63	263

southern and northern regions. Very low cheetah numbers in the far northern region disqualified it from analysis. In the central and northern regions the sex ratio was biased in favour of males, whereas it was even in the south. There were more mothers than cubless females in the southern region, whereas the converse was true in the central and northern regions. Recruitment in the southern and northern regions appeared to be in balance, where the adult to progeny ratio was even, but a deficit was evident in the central region, where the ratio was biased in favour of adults

	Southern	Central	Northern
Males: females	1:1	1:0,5	1:0,6
Cubless females: mothers	1:1,4	1:0,6	1:0,7
Adults: prolific	1:1	1:0,4	1:1

Table 2: Demographic relationships in regions.

(Table 2).

Six hundred and thirty-six diarised cheetah sightings over three years were analysed (Table 3). Regional decreases, apparent along the south-north gradient, corroborated findings from visitor-generated information, with the exception of the far northern region. On closer examination, the relatively high number of diarised sightings in the far northern region were found to stem from many records by one ranger of a single animal, rather than many records of numerous animals by all the rangers in the region. The 1992 increase in diarised sightings in the southern region was probably an artefact stemming from the diligence of newly appointed rangers.

Prior population estimates (Pienaar, 1969) put the cheetah population at about 263 individuals, a number which is considerably higher than the current census of 172 (Table 1). No explanation of this discrepancy is attempted, as the census techniques used earlier were not described in detail. The decline may be real or may be an artefact created by differing counting methods.

The disparate cheetah densities in the four regions are of interest. Only three cheetahs were recorded in the far northern region. Densities in the southern region were double those in the central region and almost five times those of the northern region (Table 1), a phenomenon confirmed by the analyses of diarised rangers' sightings (Table 3).

The mosaic of broad habitat features, such as vegetation type and structure, prey base and the local predator community of the northern and far northern regions appears very similar to that in the southern region. It is unlikely that these features contribute to any significant degree to the disparate cheetah densities. This suggests that some clandestine limiting factor is operative in the northern and far northern regions.

Because of little genetic variation (O'Brien et al, 1983), cheetahs may be especially vulnerable to disease and parasites (O'Brien et al, 1985). They are particularly susceptible to anthrax, feline enteritis (cat flu), and tick fever (Grobler et al, 1988). Anthrax, lethal to cheetahs (Marker-Kraus & Kraus, 1990; Bothma, 1990), which erupts cyclically in the north and far north (De Vos, 1990) is absent in the south. Anthrax is also implicated in the low densities of cheetahs in the Etosha National Park (Marker-Kraus & Kraus, 1990) and it may be the single limiting factor of the cheetah population in the northern and far northern regions of the Kruger National Park. A very low incidence of mange, implicated as an important mortality factor (Mills, 1990), was reported in this study.

Demographic factors were probably the main operatives which contributed to the disparate densities between the central and southern regions. The biased sex ratio in favour of males (Table 2) suggested a shortage of females in the central region with its relatively lower densities. However, unlike the southern region, cubless females outnumbered mothers

Below: A female with cubs. Photo: Anup Shah/ABPL

Table 3: Mean number of cheetah sightings reported in rangers' diaries, March 1989 to February 1992.

Area	Rangers	1990	1991	1992
Southern	6	11,3	11,0	21,7
Central	6	5,2	7,8	7,7
Northern	7	3,7	3,4	3,0
Far Northern	6	8,3	14,8	6,3

in the central region. This was unexpected, since males were relatively abundant here. This situation may have arisen from the interaction of numerous factors: infanticide may have been common as a consequence of the biased sex ratio; low densities could have resulted in males seldom encountering oestrus females; or encounters may have been adequate but fertility in females or males or both may have been low. The results of this phenomenon were probably expressed as relatively lower recruitment rates (Tables 1 and 2) in the central region.

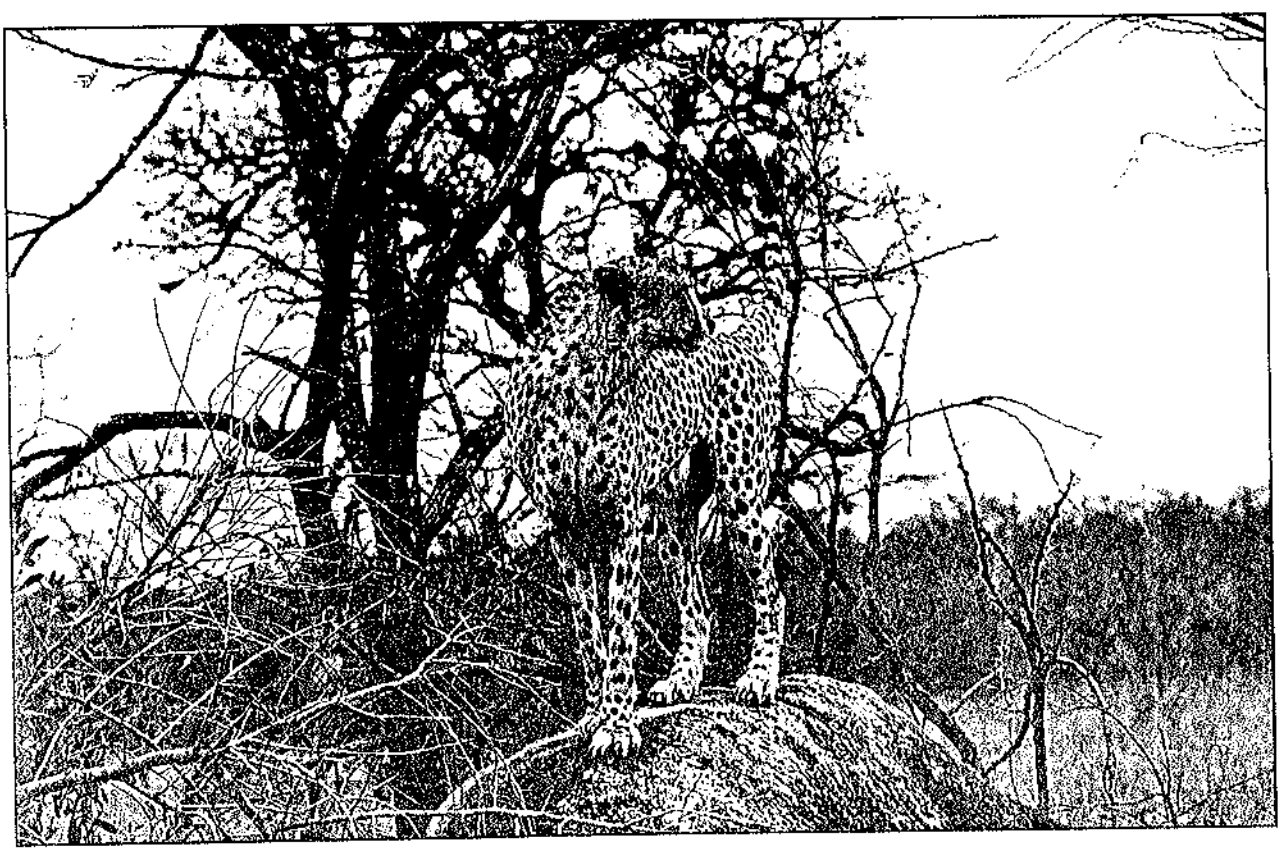
The locations of cheetah groups, positively identified from photographs (competition and survey), were used to calculate home range size and overlap. Observations were allocated to cells in a 4x4 km grid overlay, and home range was determined with the minimum convex polygon method (Mohr, 1947) for cheetah groups with more than seven locations.

Home range size, calculated for 18 cheetah groups, varied between 104 and 1 848 km^2. In male groups there was an inverse relationship between group size and home range size, whereas in female groups the relationship was direct (Figure 1). Male/female home ranges overlapped arbitrarily, and male/male home ranges showed both overlap and exclusion.

Estimates of cheetah home range sizes throughout Africa vary considerably (Table 4). An explanation of this variation, a phenomenon also encountered within the Kruger National Park, is not readily forthcoming. In this study trends are apparent which may partially explain variations in home range size.

Variations in home range size evident in the Kruger National Park may stem from the sex and size of cheetah groups. In males, group size is inversely related to home range size (Figure 1). Male coalitions enjoy increased hunting efficiency, reduced kleptoparasitism, and enhanced self-defence. These

Below: The cheetah photographic competition supplied very important information on the cheetah population of the Kruger National Park.



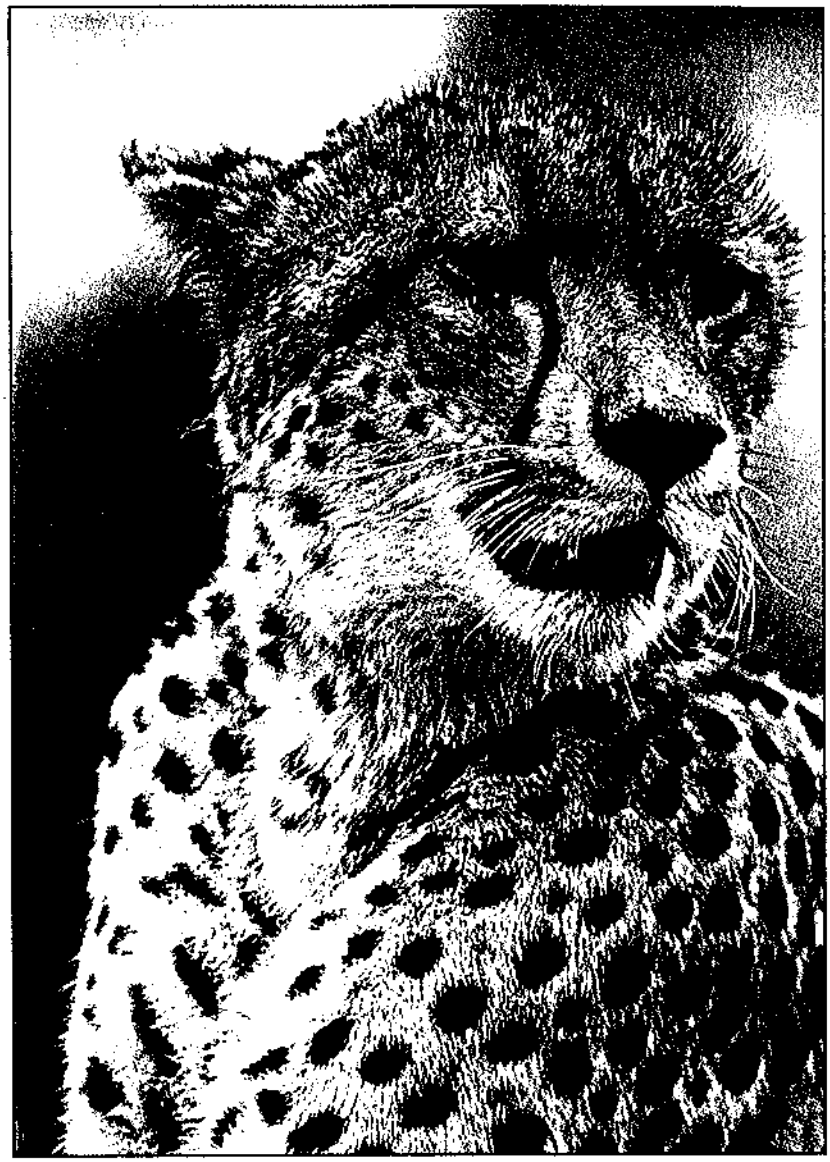
factors lend themselves to securing and retaining territories which, of necessity, are limited in size. Counteractive behaviour of solitary males would be to move over larger areas to enhance the element of surprise when hunting and to prevent encounters, usually aggressive, with male coalitions.

In the Serengeti National Park in Tanzania, Caro & Collins (1986) found that not all male cheetahs were territorial; that those who did establish territories did not necessarily occupy them all the time, and that male coalitions were more likely to hold a territory than were single males. Low prey densities and rainfall could prompt territorial males to leave.

In the Kruger National Park, between Lower Sabie and Crocodile Bridge, a coalition of three males has maintained a territory since 1985 (Mills, 1989), whereas just north of Lower Sabie the home ranges of three male coalitions overlap with each other and those of six females, three of which have cubs. However, temporal spacing among the three male groups is evident, as no more than two of the coalitions were present in the area at one time.

The direct relationship between home range size and group size in female groups (Figure 1) can probably be ascribed to solitary females being able to secure 'home and table' in smaller areas than females with cubs. Groups of females with cubs need to increase hunting frequency, and consequently area, in accordance with litter size, in order to counteract prey wariness from increased hunting pressure.

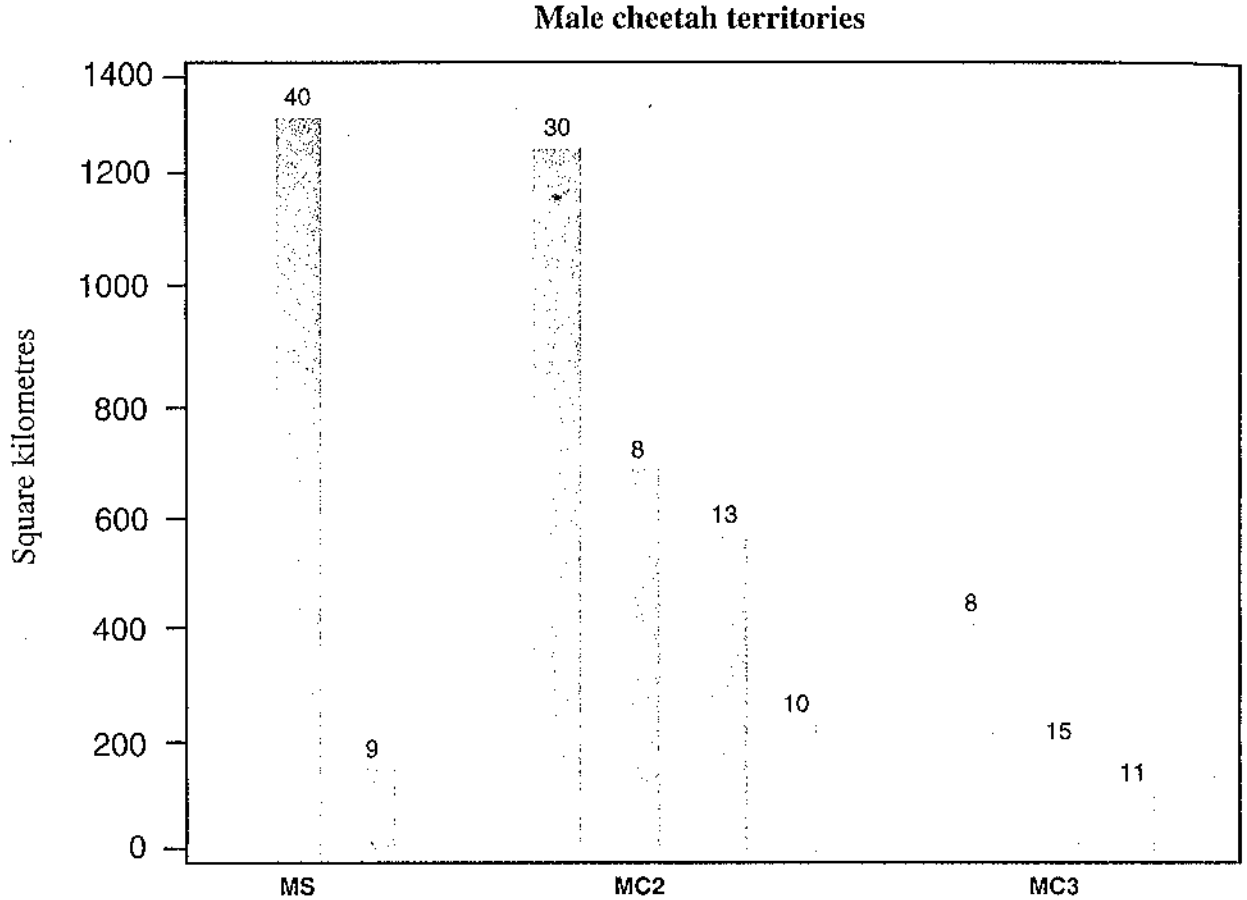
The large home ranges required by cheetahs emphasises the need to use all available space in the Kruger National Park and highlights the importance of identifying limiting factors prevalent in the northern and far northern regions.



Above: A male cheetah. Photo: M Broughton.

Time of cheetah observations recorded by visitors was used as an index of activity. The assumption was made that it was unlikely that inactive cheetahs would be seen by visitors. Since cheetahs are predominantly diurnal, activity begins at first light and declines at dusk, with prolonged resting during the heat of the day (Pettifer, 1980). The visitor-generated information supports the diurnal activity patterns of cheetahs reported elsewhere (Eaton, 1968; Skinner & Smithers, 1990). Generally speaking, cheetahs were active mid-morning and mid- to late afternoon.

Cheetahs are part of a diverse and very competitive predator community in the Kruger National Park. Kleptoparasitism on cheetah by lions and spotted hyaenas is common, and cheetah are obliged to adapt their food habits to avoid the high energy costs of kleptoparasitism (Pettifer, 1980; Stander, 1990; Mills & Biggs, *in preparation*). Feeding behaviour determined from visitor-generated information corroborates the findings of Mills & Biggs (*in preparation*) where cheetahs were classified as mid-morning/mid-afternoon hunters.



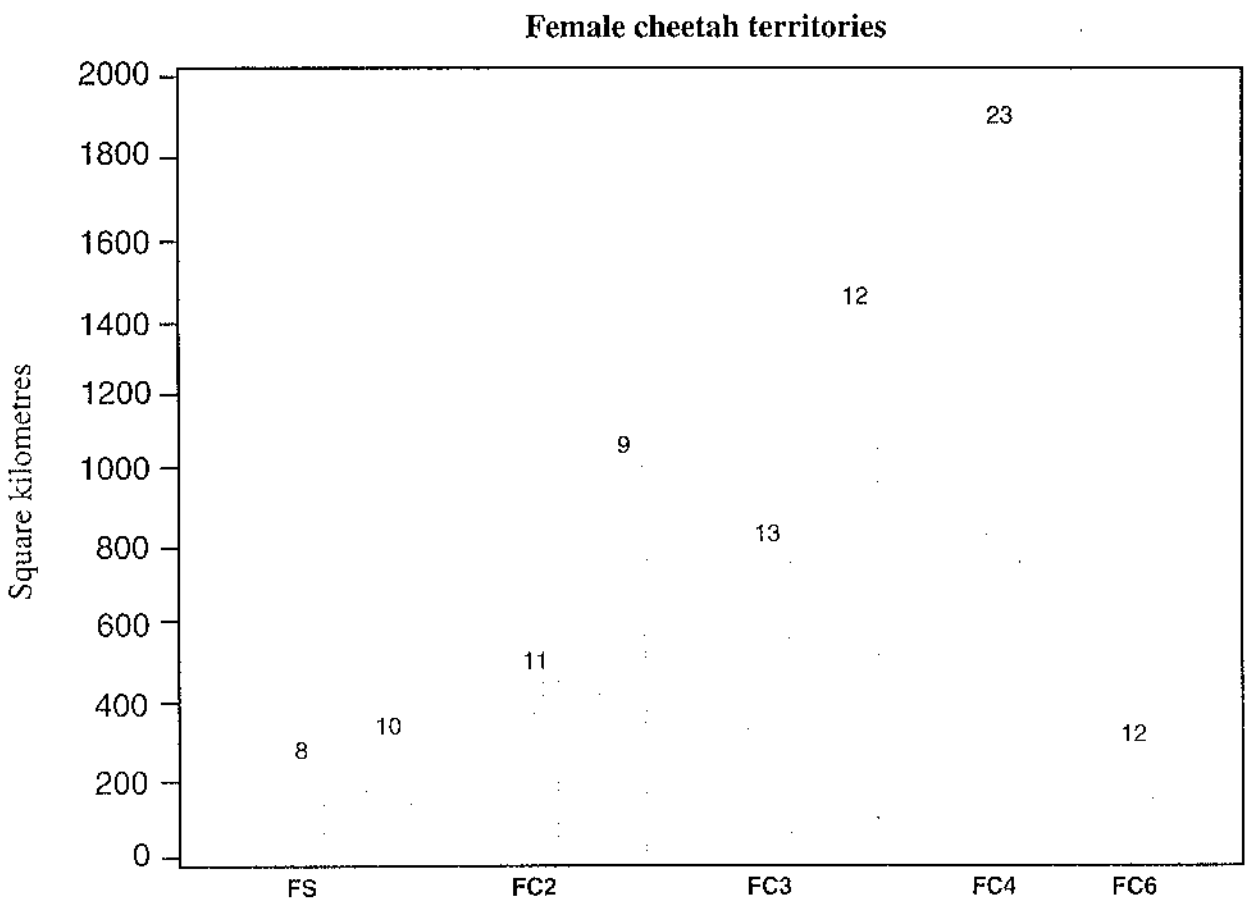


Figure 1: Sizes of the home ranges of male and female cheetahs. The group codes of table 1: number above the column = number of territories.

Peaks in hunting and feeding activity were at 09:00 and 15:00, which is later and earlier, respectively, than the general activity patterns. Impala, zebra, and warthog were the most frequent prey.

Author	Group	Size (km^2)
Mills, 1989	MC3	175
Whateley & Brooks, 1985	FC	25
Morsbach in Stuart & Wilson, 1988	FS	1 500+
Morsbach in Stuart & Wilson, 1988	MS	800
Gittelman & Harvey, 1982		67,5
Caro & Collins, 1986	FS	800

Table 4: Estimates of cheetah home ranges elsewhere in Africa (Group codes as in Table 1).

STUDY AREA

The Kruger National Park (22°31' to 25°30'E and 30°45' to 32°00'S) is 19 485 km^2 in size with an altitude varying between 200 and 900 m. Six large rivers and numerous streams trav-erse the area from west to east. Average annual rainfall varies locally (for example 375 mm at Pafuri and 750 mm at Pretoriuskop), and is usually confined to the summer months (Septem-ber to March). Droughts, which are not uncommon, ex-press the peak of the dry phase in the nine-to-ten-year 'dry-wet' cycle. Winter temperatures are usually moderate with infrequent frost, whereas summer temperature often exceed 40°C (Van Wyk, 1984).

SIZE OF REGIONS

Southern: 3 786 km^2
Central: 5 710 km^2
Northern: 5 793 km^2
Far northern: 4 196 km^2

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