Pettifer HL. 1981. Aspects on the ecology of cheetahs on the Suikerbosrand Nature Reserve. Worldwide Furbearer Conference. ; 1142 p.

Keywords: 1Afr/Acinonyx jubatus/cheetah/management/population dynamics/prey selection/research/social dominance/social grouping/Suikerbosrand Nature Reserve/territoriality

Abstract: Cheetah were relocated to the Suikerbosrand Nature Reserve between 1975 and 1976. A rapid increase in cheetah numbers with simultaneous declines in certain ungulate species warranted intensive management-oriented research. Social grouping, population dynamics and prey selection of cheetahs are briefly discussed. Home ranges are shown to overlap considerably, although an effective spacing system is in operation. Home range size appears to depend largely upon social dominance and possibly territoriality.

From: Worldwide Furbearer Proceedings.
Vol. II J.A. Chapman and D. Pursley, eds.
1981
Worldwide Furbearer Conference, Inc.

ASPECTS ON THE ECOLOGY OF CHEETAHS (ACINONYX JUBATUS) ON THE SUIKERBOSRAND NATURE RESERVE

HOWARD L. PETTIFER, Division of Nature Conservation, Transvaal Provincial Administration, Private Bag X209, Pretoria, Republic of South Africa

ABSTRACT: Cheetahs (Acinonyx jubatus) were relocated to the Suikerbosrand Nature Reserve between 1975 and 1976. A rapid increase in cheetah numbers with simultaneous declines in certain ungulate species warranted intensive management-oriented research. Social grouping, population dynamics and prey selection of cheetahs are briefly discussed. Home ranges are shown to overlap considerably, although an effective spacing system is in operation. Home range size appears to depend largely upon social dominance and possibly territoriality.

The cheetah (Acinonyx jubatus) is listed as an endangered species in Southern Africa (Skinner et al. 1977). Myers (1974, 1976) stated that Africa supports possibly as few as 10,000 cheetahs which could again be halved by 1980. Conversely, Joubert and Mostert (1975) feel that cheetahs have increased on farmland in Namibia, possibly due to the reduction in lions (Panthera leo), spotted hyenas (Crocuta crocuta) and Cape hunting dogs (Lycaon pictus) and the consequent increase in kudu (Tragelaphus strepsiceros) populations. A similar trend appears to be the case in the northern Transvaal. Either way, there is considerable public concern for the future survival of cheetahs in South Africa. The ever increasing encroachment placed upon their natural habitat by agricultural demands justifies further concern. Since cheetahs are not compatible with livestock farming, it is not presently possible to place them on the Protected Game List. To compensate for this lack of legislation, cheetahs, leopards (Panthera pardus) and wild dogs reported in cases of livestock depredation are trapped and relocated to wildlife areas in which they are tolerated.

The Suikerbosrand Nature Reserve offered the opportunity of using cheetahs in the biological control of excess small to medium sized game, in particular blesbok (Damiliscus dorcas phillipsi) which were annually cropped in fair numbers. Between August 1975 and October 1976, 8 adult

cheetahs comprising 5 males and 3 females were trapped in livestock farming areas and relocated to this reserve. Within 2 yr, the cheetah population had risen to an estimated 24 (Cohen et al. 1978) with a simultaneous dramatic drop in the blesbok and springbok (Antidorcas marsupialis) numbers. An intensive research program on relocated cheetahs was immediately launched with the major objectives of studying the predator-prey relationships, population dynamics, movements and social structure of relocated cheetahs.

This paper reports on certain aspects of the ecology of the cheetahs on the Suikerbosrand Nature Reserve with particular emphasis on home range and movements.

STUDY AREA

The Suikerbosrand Nature Reserve is situated approximately 40 km south of Johannesburg in the southcentral Transvaal (26°27' - 26°34'S, 28°09' - 28°21'E). The reserve, comprising somewhat 13,400 ha, falls within Acocks' (1953) Bankenveld, is characterized by predominantly open grassveld with dense thickets in some of the ravines. Bredenkamp and Theron (1976) classified the grasslands into 13 communities. These grassland communities are greatly affected by the diversity of the topography (the altitudes range from 1,525 m - 1,916 m).

The reserve is bisected by an east-west ridge. Two geological formations, namely the Ventersdorp System in the central and western regions and the older Witwatersrand System in the east, comprise the reserve. The latter System has undergone considerable faulting, folding and erosion (du Toit 1954) and is relatively game-free due to the sour vegetation on the quartzite soils.

The reserve lies within the summer rainfall region. Winters are cold with icy mountain winds, summers are temperate with frequent thunder, lightening and hail storms. Annual rainfall varies between 650 mm - 730 mm, the majority falling between October and March (Figure 1). Monthly mean minimum temperatures are normally below 5° C during winter, whereas the mean monthly maximum temperatures seldom exceed 27° C during summer (Figure 1).

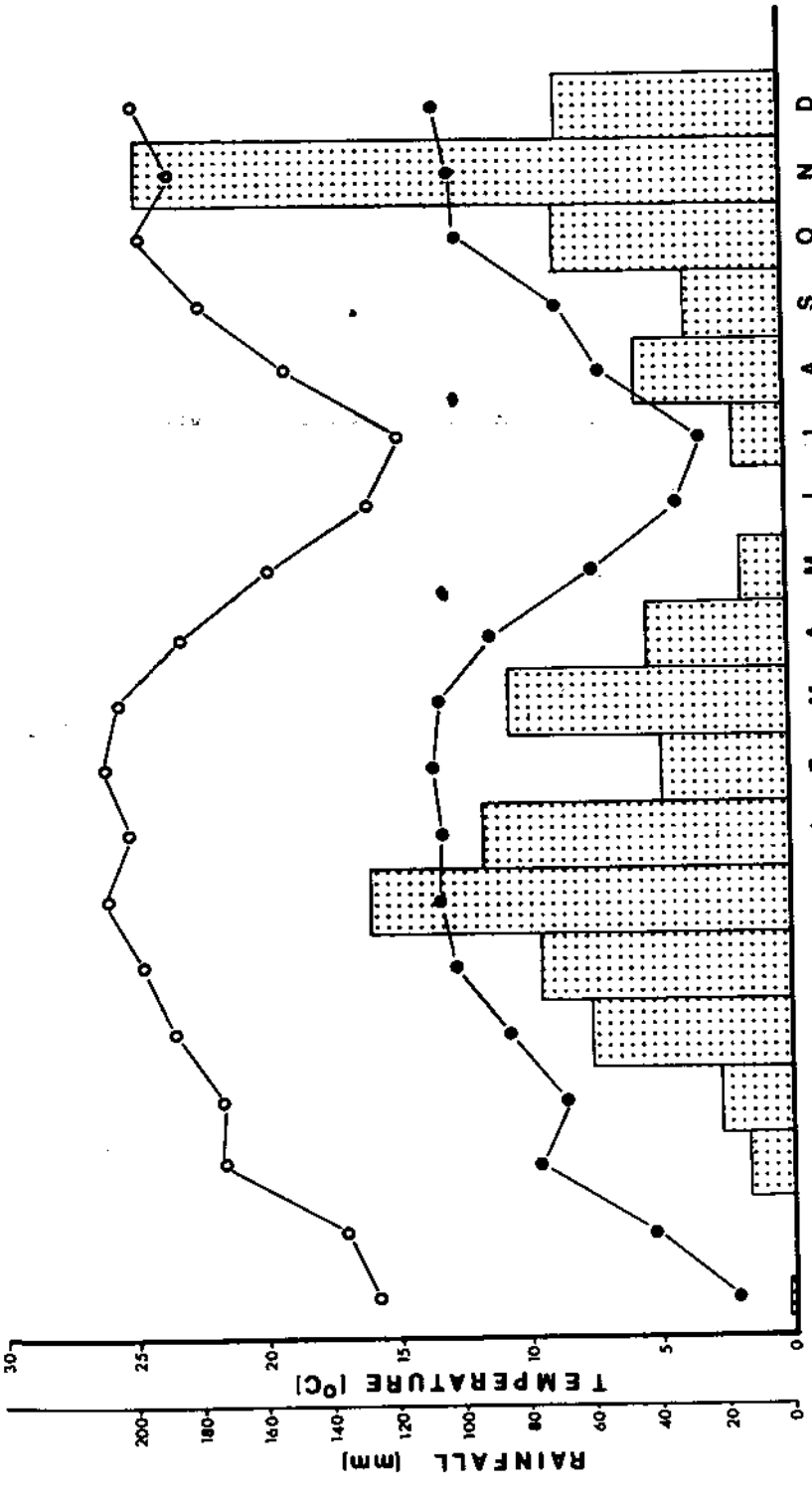

Figure 1. The monthly rainfall (histogram) and mean monthly maximum and minimum temperatures for Jan Smuts Airport, 40 km north of the Suikerbosrand Nature Reserve for June 1978 - December 1979. (Data from Weather Bureau, Department of Transport, Pretoria.)

Suikersbosrand supports 12 ungulate species of which blesbok and springbok are the most important prey species of the cheetahs. Brown hyenas (Hyaena brunnea) and black-backed jackals (Canis mesomelas) are the most important carnivores other than the cheetahs which are the terminal predators.

MATERIALS AND METHODS

Cheetahs were live-trapped on the Suikerbosrand Nature Reserve using the method developed by A.T. Scholtz (Transvaal Division of Nature Conservation, unpubl. manus.). The cheetahs were radio marked with transmitters designed by the Department of Electronic Engineering, University of Pretoria, on frequencies ranging from 148,350 MHz - 148,625 MHz. AVM-LA12 receivers (AVM Instruments Co., Illinois) with sweep option and hand-held 4-element directional yagi antennae were used in locating the marked cheetahs. A vehicle-mounted omni-directional whip antenna (ASPS 17-7) was frequently used in the initial search for an individual.

A set of ortho-aerial photographs on a 1:10,000 scale of the reserve was provided with permanent 1-km^2 grids which were further subdivided into 1-ha grids (100 m x 100 m). Each grid was identified by 3 numerals on both the x and y axes. In order to fix the locality of radio marked cheetahs, 2 sets of reading were taken from 2 positions using the directional yagi antennae. From each position compass readings were taken in the direction from which the signal was the strongest (peak) and to the left and right of the signal at the precise point where the signal becomes inaudible using earphones and the receiver set at the lowest clearly audible gain. The angle so formed by the latter 2 readings was divided by 2 and the angle formed by this line and the peak line again divided by 2 to give a final direction. A Casio fx 202P digital calculator was programmed to calculate the position of the radio marked animal by entering the coordinates of the locality of the observers and the 3 compass readings taken at each locality. A magnetic deviation of 18.6° was subtracted automatically from each reading.

Inaccuracies in plotting radio marked animals are increased the greater the transmitter-receiver distance (Heezen and Tester 1967) and the smaller the angles between reading localities and the transmitter

(Tester 1971). Plots with angles less than 10° were rejected and readings were taken as close to the animal as feasibly possible without causing any disturbance.

A further problem on Suikerbosrand was caused by the reflection of signals off the mountainous terrain. In 50 trial plots where the cheetahs were flushed after the readings had been taken, it was found that all plots except 2 fell within 100 m x 100 m of true location, the remaining 2 plots being 200 m out of true location. Both these plots were taken from distances over 4 km from the animal.

Where possible, daily plots were taken on all radio marked cheetahs. Each selected cheetah was periodically tracked on a routine basis and all data relevant to the ecology of the cheetah were recorded. Behavioral aspects and habitat descriptions were recorded onto microcassette.

For the purpose of this paper, home range was based on the minimum area method (Stickle 1954) and high utilization areas calculated by plotting the geographical position of the daily diurnal resting sites of all the study animals and by progressively excluding successive observations that contributed the most to the total home range size, until a definite core area remained which consisted of observations that were closely situated to each other. These calculations were made using a Fortran program on a Burroughs B 6700 digital computer as used by Ferguson (1980). The initial plotting of the localities of each cheetah was performed using a Versatec Plotter coupled to a Cyber 174 digital computer.

STUDY ANIMALS

The 1st cheetah was radio marked on 4 July 1978 on the Suikerbosrand Nature Reserve. The animal was an approximately 18-mo-old female (Purdey) originating from a group of 4; the other 3 were relocated to the Eastern Shores Nature Reserve in Natal. On 26 July 1978, an adult female (Mary) with 4 3-mo-old cubs was radio marked, followed by an adult female singleton (Rosina) on 18 September 1978. On 23 September 1978, 2 adult males (Kojak and Seizure) were marked, bringing the total to 3 females and 2 males. All these cheetahs are still under study.

All the study animals were immobilized using ketamine hydrochloride mixed to 250 mg per ml at the dosage rate of 12 mg per kg. Zero point five millliliters 4 percent Rompun (xylazine hydrochloride: Bayer) was added to each dose.

RESULTS

Social Structure

Throughout the study period the radio marked females were either singletons or accompanied by their cubs. Their only physical encounter with other cheetahs on the reserve was during mating with 1 of the 2 radio marked males. These males were only separated from each other during mating encounters, which seldom lasted longer than 2 days. Seizure mated with Purdey and Rosina while it appeared that Kojak mated with Mary. All sightings of unmarked cheetahs on the reserve were also of singletons or females accompanied by cubs. Mixed groups were not encountered.

Population Dynamics

The total cheetah population on Suikerbosrand was estimated at between 29 and 31 in December 1979 (Pettifer et al. 1979). Since that report, Mary has produced 6 cubs. Her cubs from her previous litter were relocated to the eastern Transvaal. A further 14 cheetah have been relocated to Nature Reserves in the Cape Province, Natal and eastern Transvaal between July 1978 and December 1979.

From July 1978 to date 8 litters totaling 33 cubs have been captured and marked. The sex ratio of cubs was 13 males:20 females, with a mean litter size of 4.13 (range 3 - 6). Mortality of cubs is low with only 5 losses among the 33 marked cubs (15.15 percent).

Home Ranges of Radio Marked Cheetahs

Home range is defined as the area habitually traversed by an individual in its normal activities within a specific period of time (Brown 1966). Burt (1943) excluded random excursion trips out of the normal home

range, but because these excursion trips are often repeated in the cheetahs, the definition described by Koeppl et al. (1975) was applied whereby only one-time excursion trips that were considerably beyond the normal home range were omitted. Accordingly by calculating the 95 percent home range area, it was found that a more realistic pattern of home ranges on Suikerbosrand was achieved.

The home ranges of the cheetahs on Suikerbosrand as described in this paper were calculated on the localities of diurnal resting sites. This method shows little difference over a long period of time to continuous half-hourly plots over a shorter period (Pettifer in prep.).

By the calculation of the 50 percent home range, the uniformity of home range use or the converse can be readily determined. The sizes of the 50 percent and 95 percent home ranges of the study animals are given in Table 1.

Table 1. The number of radio-telemetry fixes on daily diurnal resting sites and sizes of the 50 percent and 95 percent home ranges of radio marked cheetahs on the Suikerbosrand Nature Reserve. (All data through December 1979)

Individual	Date Marked	Number of Days Plotted	Size of 95 percent Home Range (km^2)	Size of 50 percent Home Range (km^2)
Purdey	4 Jul 1978	161	85.9	34.6
Mary	26 Jul 1978	167	69.5	14.4
Rosina	18 Oct 1978	123	74.3	30.1
Kojak and Seizure	23 Oct 1978	151	48.8	7.7

Figure 2 shows the plotted localities of Purdey as well as her 95 percent and 50 percent home range. When the 50 percent home range area was doubled, no significant difference from the 95 percent home range size was evident ($\chi^2 = 0.01$, $p = 0.05$), thus indicating no significant preference for any given area. From the locality plots, however, it would appear that Purdey spent much time in the southeastern sections of the

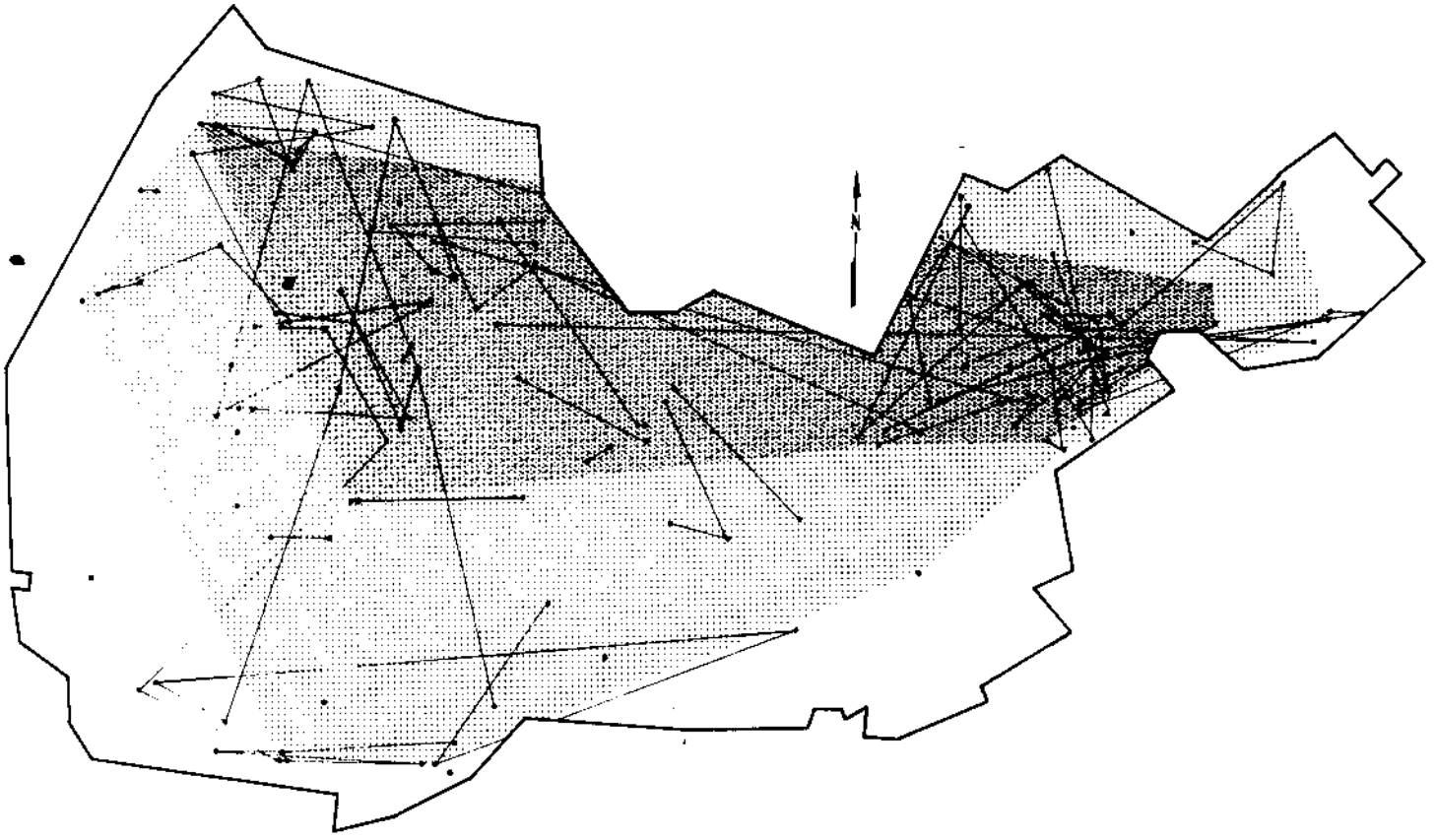

Figure 2. Daily radio-telemetry fixes on the diurnal resting sites of Purdey on the Suikerbosrand Nature Reserve. (The dark shaded area represents her 50 percent home range and the lighter shaded area the 95 percent home range. Joined plots represent consecutive days.) (n = 161)

reserve. This can be ascribed to the considerable time she spent in this area during whelping of her cubs in early June 1979. Throughout June she remained in this area, but on 2 occasions was observed as far as 7 km away from her cubs. While a singleton, Purdey appeared to roam ad lib throughout her home range and was noted to have traversed large sections of the reserve in a single day. The joined plots indicate consecutive days. The greatest straight-line distance between consecutive diurnal resting sites was 8.7 km.

Mary (Figure 3) had a somewhat smaller home range than Purdey or Rosina. Her 50 percent home range was significantly less than half the 95 percent home range ($\chi^2 = 23.83$, $p = 0.05$), indicating a definite area of preference. Mary was accompanied by 4 cubs when marked. These cubs broke ties with her during September 1979. She produced 6 cubs during December 1979. She whelped these cubs in the preferred area and with both litters remained reasonably within this area. She did, however, undertake several excursion trips, which differed from those of the males in that they normally stretched over several days, with the exception of those to the east of the reserve. These excursion trips greatly influenced the determination of her home range. Although Mary had a more predictable home range, and distances between consecutive diurnal resting sites were normally short, she did on occasion move considerable distances in a single day - the greatest straight-line distance being 12.5 km. Rosina (Figure 4) showed a similar uniform utilization of her 95 percent home range to Purdey (2 x 50 percent home range not significantly different from 95 percent home range, $\chi^2 = 3.30$, $p = 0.05$). During February 1979 she gave birth to 3 cubs in the central-western section of the reserve. Once her cubs were mobile, she exhibited a more unpredictable pattern of movement and yet again moved large distances over short periods - the greatest straight-line distance between diurnal resting sites being 13.8 km. Rosina, undoubtedly the most mobile of all the radio marked cheetahs, was on 1 occasion followed for 26 km in 8 hr. Rosina spent very little time within Mary's preferred area.

The males Kojak and Seizure showed a more predictable home range (Figure 5). Their 50 percent home range was significantly smaller than half the 95 percent home range ($\chi^2 = 22.86$, $p = 0.05$) suggesting a well defined

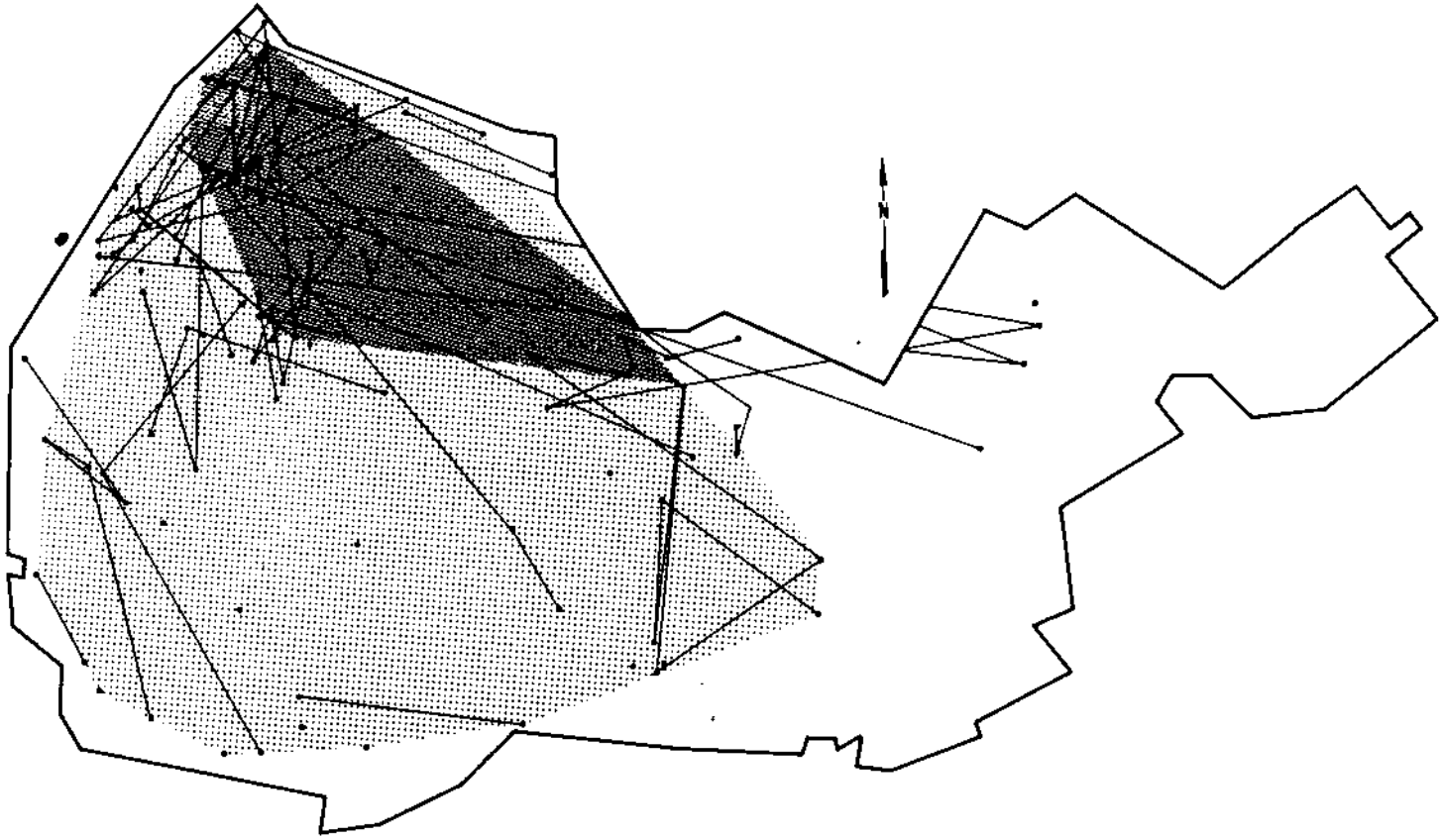

Figure 3. Daily radio-telemetry fixes on the diurnal resting sites of Mary on the Suikerbosrand Nature Reserve. (The dark shaded area represents her 50 percent home range and the lighter shaded area the 95 percent home range.

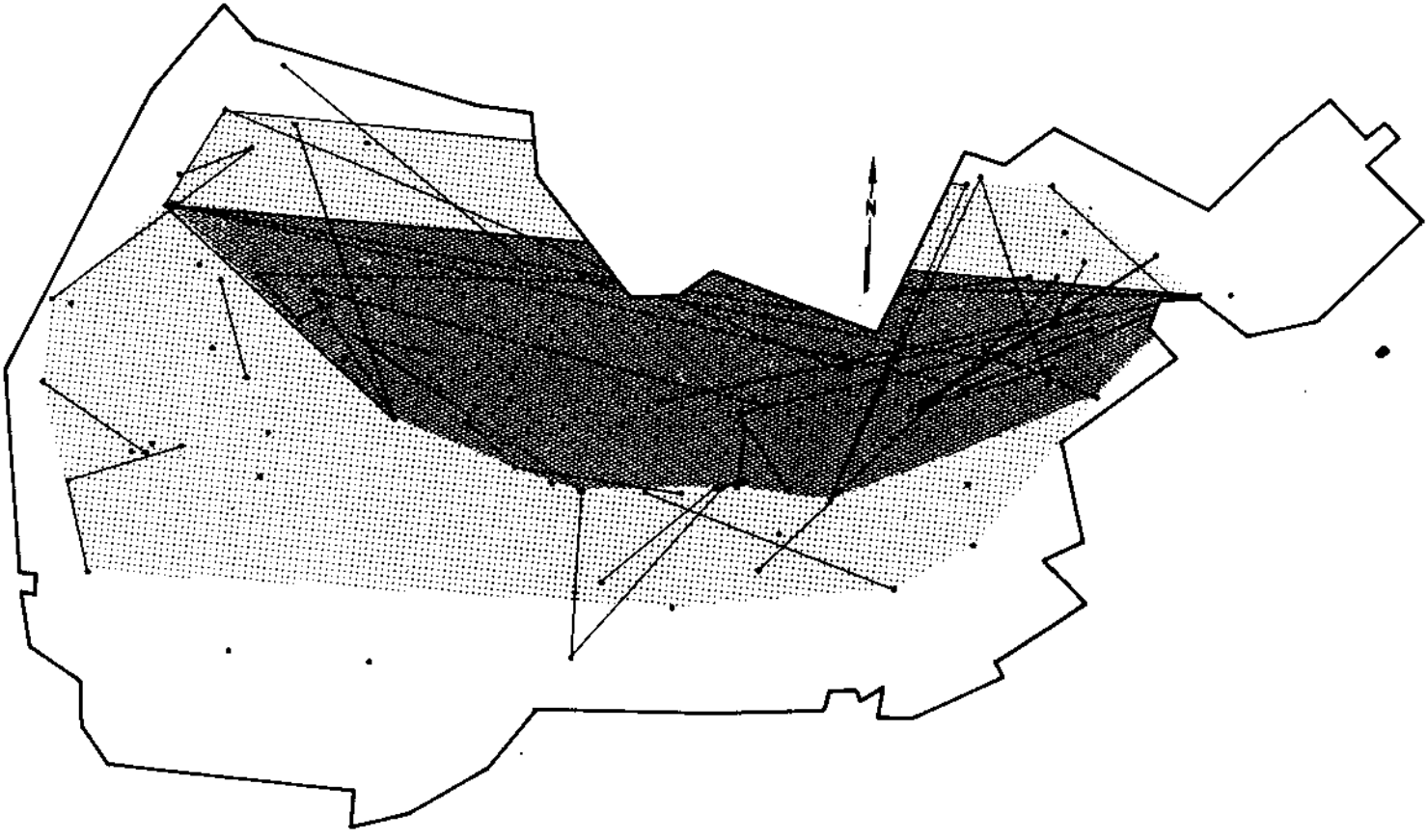

Figure 4. Daily radio-telemetry fixes on the diurnal resting sites of Rosina on the Suikerbosrand Nature Reserve. (The dark shaded area represents her 50 percent home range and the ligher shaded area the 95 percent home range. Joined plots represent consecutive days.) (n = 123)

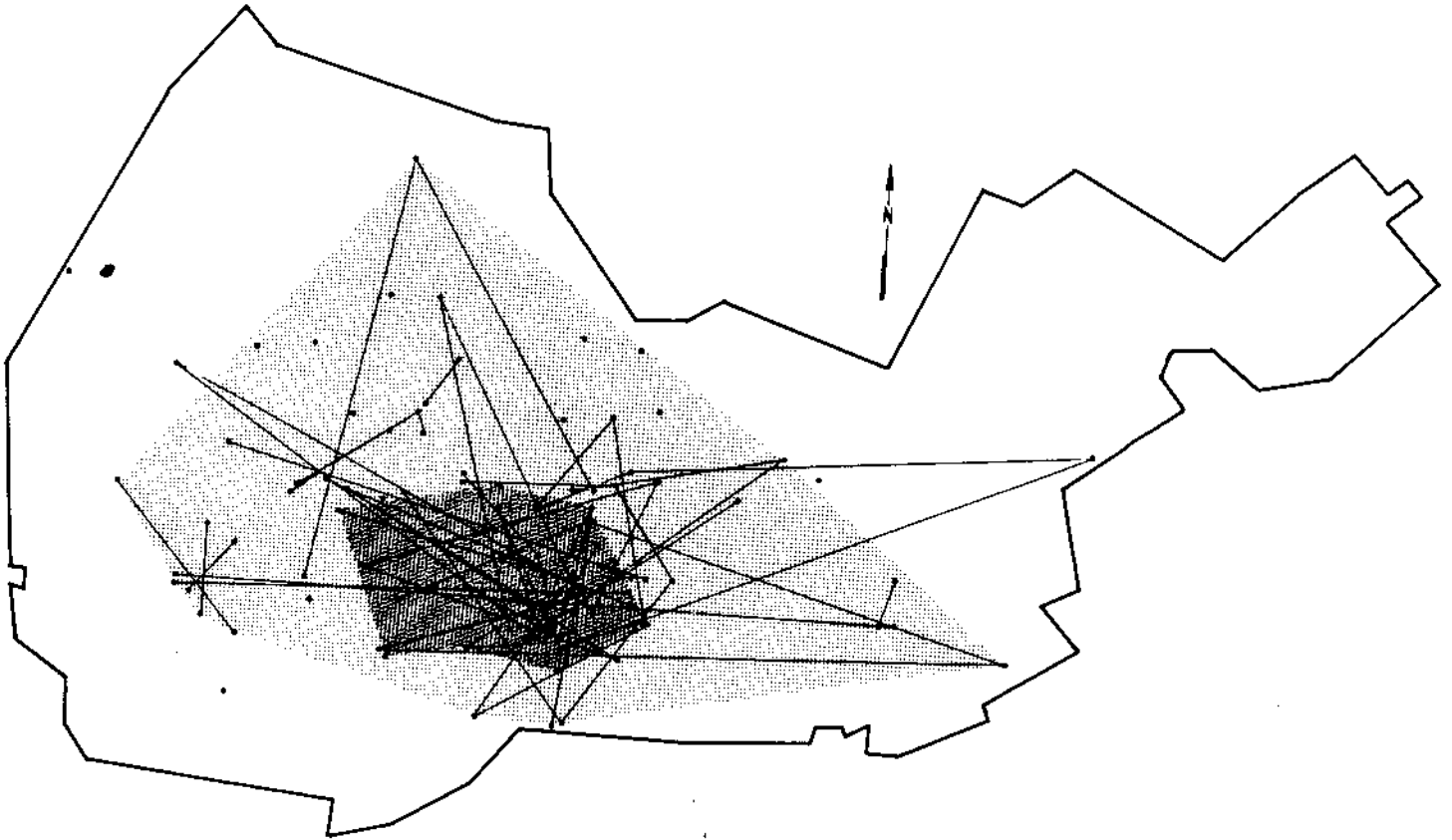

Figure 5. Radio-telemetry fixes on the diurnal resting sites of Kojak and Seizure on the Suikerbosrand Nature Reserve. (The dark shaded area represents their 50 percent home range and the lighter shaded area the 95 percent home range. Joined plots represent consecutive days.) (n = 151)

preferred area. Several short duration excursion trips occurred, often over reasonably large distances. They consistently returned to their preferred area the following day with the exception of a few excursions to the west of their preferred area (this area was included in the 60 percent home range).

In all cases the radio marked cheetahs seldom returned to the identical spot even when they had spent considerable time within an area. No tree or bush could be identified as a regular visiting site. The selection of sleeping or resting sites was opportunistic with the provision that the site offered a clear panoramic view of the surrounding area - normally situated on high ground.

Cheetah Movements in Relation to Prey Movements

The cheetahs on Suikerbosrand hunt predominantly within the shaded areas shown in Figure 6. These areas concur with the preferred habitats of blesbok and springbok on the reserve. Although cheetahs are commonly regarded as animals of vast open plains, the contrary was observed at Suikerbosrand. The cheetahs tended to utilize the slopes and ravines and very seldom ventured out onto the plains. They did, however, frequently roam the smaller plateaus and open valley bottoms where, along with the slopes, the majority of kills were made.

On no occasion were cheetahs observed to follow prey herds for any length of time. The general trend was to make their kill, eat their fill, then vacate the area.

Predator-Prey Relationships

Blesbok are the principal prey species of cheetahs on Suikerbosrand. Table 2 summarizes prey species deficits on the reserve between November 1978 and November 1979. These data were accrued by direct observations on cheetah kills as well as from carcasses recorded during regular line-sweeps conducted on the reserve. Although not all the deficits can be ascribed to cheetahs, it can be safely postulated that the majority of them were cheetah kills. Of particular interest is the high proportion of blesbok females and juveniles selected.

Figure 6. The major hunting areas of cheetahs on the Suikerbosrand Nature Reserve superimposed on the topographical map. (Contour intervals 60 m)

Table 2. Recorded cheetah kills and carcasses located in the field on the Suikerbosrand Nature Reserve between November 1978 and November 1979.

Species	A(M)[a]	A(F)	Yearlings	Lambs	Sex/Age Not Determined	Total
Blesbok *Damiliscus dorcas phillipsi*	11	49	33	11	24	128
Springbok *Antidorcas marsupialis*	13	2	2	2	1	20
Duiker *Sylvicapra grimmia*	6	4	2	-	3	15
Grey Rhebuck *Pelea capreolus*	6	-	-	-	3	9
Mountain Reedbuck *Redunca fulvorufula*	4	-	-	-	-	4
Oribi *Ourebia ourebi*	4	1	-	-	-	5
Steenbuck *Raphicerus campestris*	1	-	-	-	1	2
Unidentified[b]						32
						215

[a] A = adult.

[b] Comprises predominantly the females of oribi, steenbuck, mountain reedbuck and grey rhebuck.

From regular helicopter censuses on the reserve and the careful monitoring of the blesbok lambing season a total deficit of 266 blesbok was recorded between September 1978 and August 1979, giving a total blesbok mortality to cheetah ratio of 11.6 per annum [based on a cheetah population of 23 (Pettifer et al. 1979)]. With the cheetah population at approximately 30 (December 1979) the postulated blesbok mortality for 1980 will be in excess of 348. This excludes all other prey species.

DISCUSSION AND CONCLUSIONS

Social Structure

Eaton (1970a,b, 1974) reported adult groups consisting of both sexes in cheetahs in the Nairobi National Park. Wrogemann (1975) states, however, that McLaughlin's study on cheetahs in the same park showed no mixed adult groups. Graham and Parker (1965) recorded mixed adult groups from a questionnaire survey. Schaller (1972) reported a similar social structure for the Serengeti as that at Suikerbosrand with adult singletons, small all-male groups and females accompanied by cubs and no mixed adult groups. He maintains that the all-male groups consist of littermates, a point we were unable to verify due to the short study period, although this did appear to be the case.

A possible explanation to Eaton's (1970a,b, 1974) findings is that the mixed groups he studied were littermates recently separated from their mother. The only litter to have broken ties with their dam on Suikerbosrand during the study period was Mary's, this having taken place when the cubs were approximately 16.5-mo-old. The littermates stayed together for 3 mo before being trapped and relocated to the eastern Transvaal. With 3 litters presently being studied, it is hoped that the period in which littermates remain together can be recorded.

Questionnaire surveys are unreliable at the best of times; because it often takes an experienced observer to distinguish the dam from a litter over 12-mo-of-age or to distinguish litters recently having left the dam, it can be concluded that mixed groups are only of a temporary nature and normally consist of littermates.

Population Dynamics

The cheetah population density on the Suikerbosrand Nature Reserve at the end of December 1979 was 1/450 ha, this notwithstanding the removal of 16 cheetahs in the foregoing 18 mo. This density was somewhat 7 times higher than that reported for the Nairobi National Park (Graham and Parker 1965). Myers (1975) and Eaton (1970a, 1974) stressed the high mortality of cheetah cubs to predation by the larger predators, in

particular the spotted hyena. Since the cheetah is the terminal predator on Suikersrand, this hypothesis was further supported by the low mortality rate of cubs at Suikerbosrand.

Data on sex ratios of wild cheetahs are scanty. Schaller (1972) did, however, report a sex ratio in favor of females, as did Wrogemann (1975) in her summary of the literature. A point worth mentioning is that the sex ratio of cubs on Suikerbosrand appears to be moving towards equality, since the ratio of 1:2.5 (6:15) in favor of females in 1979 (Pettifer et al. 1979) has narrowed to 1:1.5 (13:20) at present. These discrepancies in sex ratio can probably be attributed to the small sample size.

Home Range in the Cheetah

In the cheetahs at Suikerbosrand, a clearly defined home range is not evident since the outside plots are situated far from each other, a trend one would expect from a predator that has to roam large areas in search of prey. A similar finding was described by Ferguson (1980) for black-backed jackals.

There was considerable overlap in the home ranges of all the radio-collared cheetahs on Suikerbosrand; in fact, the home ranges of Purdey and Rosina were very similar in shape, size and location. Mary, on the other hand, showed a distinct preferred area. Initially it was thought that this preference was due to her being accompanied by cubs while the other 2 females were singletons, and that there appeared to be a system of respect and right-of-way to a female with cubs. From the time all the radio-collared females were accompanied by cubs, it was found that both Purdey and Rosina continued to give Mary the right-of-way, possibly indicating Mary to be the dominant female since the preferred area always carries a high density of potential prey species.

Eaton (1970a, 1974) advocates a "time plan" territorial system in cheetahs, whereby scent marking is used to warn conspecifics. He does mention, however, that urination in females is solely excretory, except when they are in estrus. A captive adult female used for behavioral studies persistently urine marked on conspicuous objects within her camp

and defecated only on specific spots. Schaller (1967) also found female tigers and lions to urine mark.

In the present study males were noted to mark in 3 ways: by retrograde spray urination of conspicuous objects, by defecating on conspicuous objects or mounds and by scratching trees. Antagonistic behavior of cheetah males was recorded by Stevenson-Hamilton (1947), in both cases culminating in the death of 1 animal. In a recent study on captive-bred cheetahs released into the wild, a fight developed between a resident group of male cheetahs and the study animals, with 1 of the animals seriously injured (Pettifer 1981). Strange cheetahs, both males and females not in heat, placed into a camp with other cheetahs at the De Wildt Cheetah Breeding Station, Pretoria, will culminate in intensive fighting (D. Meltzer, pers. comm.). Since aggressive behavior in cheetahs in the wild appears to be rare, it can be concluded that an effective spacing system is in operation, probably controlled by scent marking. This is further supported when considering the amount of time cheetahs have been noted to smell around marked bushes, trees or feces.

Territoriality as defined by Noble (1939) as any defended area against conspecifics cannot be discounted, particularly, if scent marking is regarded as a form of defense or territorial advertisement. What deserves verification is whether cheetahs defend a specific area or the immediate proximity in which they encounter other cheetahs, and what and when is aggressive behavior elicited.

Predator-Prey Relationships

Blesbok are the most abundant ungulates on Suikerbosrand and are encountered in large herds of over 500 and small herds of less than 20. Cheetahs show a high preference for hunting from the smaller herds (Pettifer et al. 1979), a similar observation was made by Eaton (1970b) in the Nairobi National Park.

Of importance was the high proportion of blesbok females and juveniles taken at Suikerbosrand. Sex and age ratios of prey in the literature vary considerably, for example Schaller (1968) found that 54 percent o

Thompson's gazelle (Gazella thompsoni) killed by cheetahs were subadult and that there appeared to be no selection for sex in the adult class, whereas Kruuk and Turner (1967) found a preference for adult females in the same species. Likewise, prey species selection appears to vary, for example Pienaar (1969) found reedbuck (Redunca arundinum) to be an important prey species in the Kruger National Park, while Mitchell et al. (1965) found reedbuck not to be important at Kafue National Park, Zambia, even though they were more abundant there.

Kruuk and Turner (1967) postulated that selection for female prey could be due to females fleeing 1st and thus stimulating the cheetahs to give chase. Eaton (1972) showed experimentally that the flight of prey releases attack in cheetahs.

Eaton (1970b) also stated that there appears to be a differential selection for females and juveniles. On Suikerbosrand, the selection for females and juveniles could be due to the size category of the prey. Adult male blesbok weigh over 80 kg. Blesbok are not agile animals and individual selection is thus made easier.

Implications of Cheetah on the Suikerbosrand Nature Reserve

The reproductive success of cheetahs on Suikerbosrand has already led to the relocation of 16 cheetahs. A simultaneous phenomenal breeding success of cheetahs in captivity has been achieved at the De Wildt Cheetah Breeding Station near Pretoria. The advantage of the Suikerbosrand cheetahs is, however, the fact that they are born and reared in the wild and are thus easily relocated to natural areas, although it has also been established that captive-bred cheetahs may adapt to life in the wild (Pettifer 1981).

The success of cheetahs on Suikerbosrand is not without its repercussions. With the rapid increase of cheetahs, a drastic reduction in certain prey species, particularly blesbok and springbok, has followed. In the absence of other large predators, limiting factors which could operate on the cheetahs on Suikerbosrand at present are depletion of food resources, disease, and social intolerance. At present, none of these factors appear to have any significant influence.

Suikerbosrand, being situated close to Johannesburg, is an important outdoor recreation center with game-viewing as an integral facet. To allow the cheetah population to stabilize by depletion of its own food supply can thus not be considered. The cheetah population will therefore always have to be managed.

One of the major questions that now arises is to what level should the cheetah population be managed? The establishment of a safe cheetah to prey ratio is complicated by the obvious selection of cheetahs on this reserve for female blesbok. Furthermore, experience has shown that the trapping of cheetahs is both expensive and time-consuming with its own limitations in that certain individuals are repeatedly captured, whereas others actively avoid the traps.

At present, the blesbok population is being augmented by excess stock from other reserves. This will probably have to be continued until such time as the blesbok reach numbers whereby their increment will greatly surpass the predation rate to allow for the cropping of excess rams to balance out the sex ratio.

The research at Suikerbosrand is being continued in order to find a practical management policy.

ACKNOWLEDGMENTS

This study could not have been undertaken without the support and enthusiasm of my field technicians Koos de Wet and Piet Muller - to them a special word of thanks.

J.W.H. Ferguson was a great help in the final computation of data and critically reviewed this paper. The staff on the Suikerbosrand Nature Reserve are thanked for their help in many ways. Dr. E. Young and S. Wolff are acknowledged for useful comment throughout the duration of this study. The Problem Animal Control Unit, Transvaal Division of Nature Conservation, was responsible for most of the trapping of cheetahs on the reserve. The Director of Nature Conservation granted permission to attend the Conference and publish this paper.

LITERATURE CITED

ACOCKS, J.P.H. 1953. Veld Types of South Africa. Mem. Bot. Surv. South Africa 28. Government Printer, Pretoria, South Africa. 192 pp.

BREDENKAMP, G.J., and G.K. THERON. 1976. Vegetation units for management of the grasslands of the Suikerbosrand Nature Reserve. South African J. Wildl. Res. 6:113-122.

BROWN, L.E. 1966. Home range and movement of small mammals. Symp. Zool. Soc., London 18:111-142.

BURT, W.H. 1943. Territoriality and home range concepts as applied to mammals. J. Mammal. 24:346-352.

COHEN, M., A.T. SCHOLTZ, and G. REICHEL. 1978. A preliminary survey of the cheetah, Acinonyx jubatus on the Suikerbosrand Nature Reserve. Transvaal Div. Nat. Conserv., Pretoria, South Africa. (Mimeo).

Du TOIT, A.L. 1954. The Geology of South Africa. 3rd ed. Oliver and Boyd, Edinburgh, Scotland.

EATON, R.L. 1970a. Group interactions, spacing and territoriality in cheetahs. Z. Tierpsychol. 27:481-491.

_____. 1970b. Hunting behaviour of the cheetah. J. Wildl. Manage. 34:56-67.

_____. 1972. An experimental study of predatory and feeding behaviour in the cheetah (Acinonyx jubatus). Z. Tierpsychol. 31:270-280.

_____. 1974. The Cheetah. The Biology, Ecology and Behaviour of an Endangered Species. Van Nostrand Reinhold Co., New York, New York. 178 pp.

FERGUSON, J.W.H. 1980. Die Ekologie van die Rooijakkals Canis mesomelas Schreber 1778 met spesiale verwysing na Bewegings en Sosiale Organisasie. M.Sc. Thesis. Univ. Pretoria, Pretoria, South Africa.

GRAHAM, A.D., and I.S.C. PARKER. 1965. East African Wildlife Society cheetah survey: report by Wildlife Services. East African Wildl. Soc., Nairobi, Kenya. (Mimeo).

HEEZEN, K.L., and J.R. TESTER. 1967. Evaluation of radio-tracking by triangulation with special reference to deer movements. J. Wildl. Manage. 31:124-141.

JOUBERT, E., and P.K.N. MOSTERT. 1975. Distribution patterns and status of some mammals in South West Africa. Madoqua 9:5-44.

KOEPPL, J.W., N.A. SLADE, and R.S. HOFFMAN. 1975. A bivariate home range model with possible application to ethological data. J. Mammal. 56:81-90.

KRUUK, H., and M. TURNER. 1967. Comparative notes on predation by lion, leopard, cheetah and wild dog in the Serengeti area, East Africa. Mammalia 31:1-27.

MITCHELL, B.L., J.B. SHENTON, and J.C.M. UYS. 1965. Predation on large mammals in the Kafue National Park, Zambia. Zool. Africana 1:297-318.

MYERS, N. 1974. Institutional inputs for cheetah conservation in Africa. Trans. 39th N. Am. Wildl. Conf. Pp. 323-331.

_____. 1975. The cheetah's relationship to the spotted hyaena: Some implications for a threatened species. Proc. 1975 Pred. Symp., Univ. Montana, Missoula, Montana.

_____. 1976. The cheetah in Africa under threat. Env. Aff. 5:617-647.

NOBLE, G.K. 1939. The role of dominance in the social life of birds. Auk 56:263-273.

PETTIFER, H.L. 1981. The experimental release of captive-bred cheetah into the natural environment. In: Worldwide Furbearer Conference Proceedings (J.A. Chapman and D. Pursley, eds.). R.R. Donnelley and Sons, Co., Falls Church, Virginia.

_____, J.I. De WET, and P.J. MULLER. 1979. The ecology of cheetah (Acinonyx jubatus) on the Suikerbosrand Nature Reserve. Transvaal Div. Nat. Conserv., Pretoria, South Africa. (Mimeo).

PIENAAR, U. de V. 1969. Predator-prey relationships amongst the larger mammals of the Kruger National Park. Koedoe 12:108-176.

SCHALLER, G.B. 1967. The Deer and the Tiger. University of Chicago Press, Chicago, Illinois.

_____. 1968. Hunting behaviour of the cheetah in the Serengeti National Park. East African Wildl. J. 6:95-100.

_____. 1972. The Serengeti Lion. University of Chicago Press, Chicago, Illinois.

SKINNER, J.D., N. FAIRALL, and J. du P. BOTHMA. 1977. South African Red data book - large mammals. South African Nat. Sci. Prog. Rept. 18:1-29.

STEVENSON-HAMILTON, J. 1947. Wildlife in South Africa. Cassell, London, England. 364 pp.

STICKLE, L.F. 1954. A comparison of certain methods of measuring ranges in small mammals. J. Mammal. 35:1-15.

TESTER, J.R. 1971. Interpretation of ecological and behavioural data on wild animals obtained by telemetry, with special reference to errors and uncertainties. Symp. Biotelemetry S 57, C.S.I.R., Pretoria, South Africa.

WROGEMANN, N. 1975. Cheetah Under the Sun. McGraw-Hill Book Co., Johannesburg, South Africa. 159 pp.