A Pilot GPS Study on a Single Male Cheetah in Zimbabwe

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While considered to be a threatened species globally following historic declines in numbers and distribution (Cat Specialist Group 2002), the cheetah *Acinonyx jubatus* has a paradoxical status in Zimbabwe. Here, the cheetah is a protected species (DNPWLM 1991), but it is also perceived to be a 'problem' predator blamed for livestock losses on farmland (Masulani 1999, Taylor 1999). Consequently, many landowners have sought to remove animals from their properties, replicating the treatment of cheetah in other parts of their range (Marker *et al*. 2003).

As suggested elsewhere in Africa (Durant 1998, Marker *et al.* 2003), competition with other large predators is believed to be a key factor limiting numbers of cheetah in Zimbabwe's protected areas. In contrast, the eradication of these species together with an increase of the natural prey base on commercial farmland following the growth of the wildlife industry saw an apparent rise in numbers of cheetah from the mid-1970s (Masulani 1999, Purchase & Vhurumuku 2005). Evidence for the improving fortunes of cheetah in Zimbabwe during this period was largely anecdotal, but supported by growing reports of livestock losses (DNPWLM 1991).

Although thought to be reasonably widely distributed across parts of the country, robust population estimates for cheetah have yet to be established in Zimbabwe (Masulani 1999, Purchase 2003). Indeed, few scientific data are available on the species, particularly outside of the national parks estate (e.g. Purchase & du Toit 2000, Zank 1995). Moreover, the recent land redistribution programme has further complicated understanding of the conflict between livestock owners and cheetah as rapid and extensive changes in land use bring risks of habitat fragmentation and depletion of prey species. Nevertheless, efforts are being made to determine impacts on cheetah through interviews with resettled and established communal farmers in key areas (Chihona 2006, Lunt & Bowman 2006). While this approach can yield important information on the presence of cheetah and variables affecting their status, it is difficult to determine whether relatively few individuals exist that utilise large areas or whether the species is actually more numerous.

Information on the home range and movement patterns of cheetah is needed to produce a more rigorous evaluation of the status of this species in Zimbabwe. Global Positioning System (GPS) collars have been widely and successfully used to improve knowledge of large-scale animal movements, including with big cats (Soisalo & Cavalcanti, 2006). Hence, this technology was considered an appropriate method for use with cheetah, particularly where there was potential for individuals to travel over large distances, crossing land use and ownership boundaries. However, given the relatively high cost of GPS collars, a pilot study was undertaken to ensure their efficacy and practical application in this environment.

Study site

This preliminary study was carried out in the Malilangwe Estate, situated in Zimbabwe's South-east Lowveld (31.70°-32.00° E and 21.25°-20.84° S). The area is adjacent to Gonarezhou National Park to the south, communal land to the east and south-west and to a new settlement to the north. With the exception of the western boundary, the *c.* 400 km² conservancy is enclosed by an electrified game-proof fence.

Method

A single adult male cheetah (Fig. 1, 3.) was fitted with a GPS collar (GPS-3300 from LOTEK® Fish and Wildlife Monitoring Systems, 115 Pony Drive, New Market, ON L3Y7B5, USA), with mortality signal, VHF permanent transmitter to help track the study animal and a drop-off unit. The GPS unit was set to record the position of the study animal every four hours (00:00, 4:00, 8:00, 12:00, 16:00 & 20:00hrs) during a six-month period between the 13 th December 2003 and the 15th June 2004.

Fig. 1. Study animal after eating near the spot where it was later darted (Photo M. Homann).

Data Treatment & Analysis

Locations of the cheetah were plotted on a digital map of commercial farm boundaries (courtesy of WWF-SARPO) and the boundaries of the entire Malilangwe Estate (Georeferencing Zimbabwe 36) using ArcView GIS software (Version 3.2, ESRI, Redlands, CA). Home ranges were determined using the Arcview Animal Movement extension (Hooge 1999) based on Minimum Convex Polygon (MCP), and 95% and 50% kernel estimates, for which the automatic value for the smoothing parameter *h* was selected. MCP home ranges were compared during wet (December to March) and dry (April to June) seasons. The number of fixes required to calculate home range was determined by plotting number of fixes against

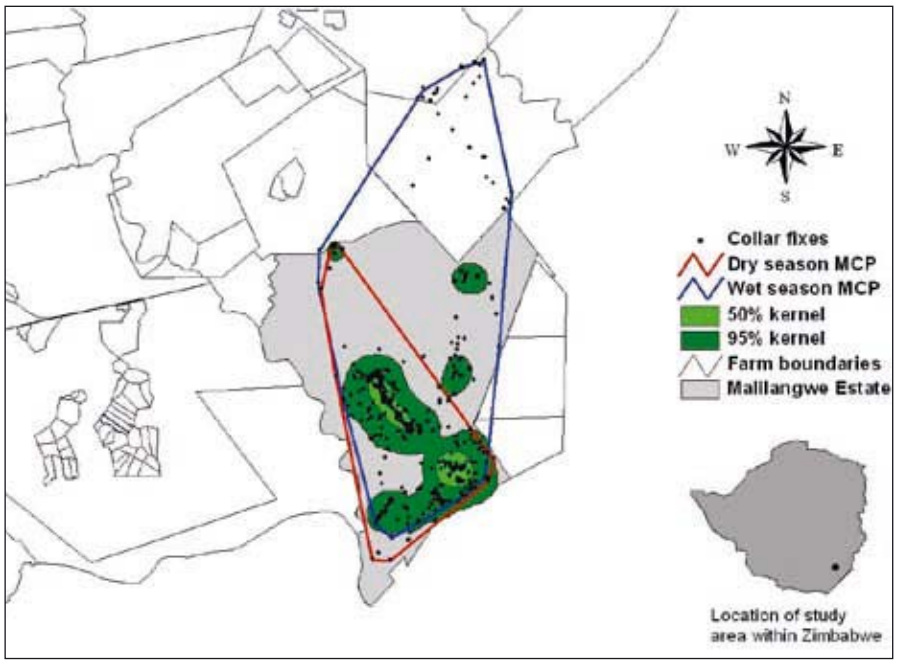

Fig. 2. Home ranges of an adult male cheetah during a six-month period based on 95% and 50% kernel estimates, regardless of season.

home range size until an asymptote of home range was reached (Harris *et al.* 1990).

Results

A total of 992 fixes were recorded, with a home range asymptote being reached after about 300 fixes. The total area utilised by the cheetah over the duration of the study was 452.7km² based on MCP, with core home range based on 95% and 50% kernel estimates of 108.33km² and 14.15km² respectively (Fig. 2). Seasonal differences were marked as the core home range of the cheetah during the dry season reduced to around a quarter of that utilised during the wet season (Table 1).

Table 1. Seasonal home range estimates of an adult male cheetah (km²).

		Kernel	
	MCP	95%	50%
Wet season	427.3	172.5	18.2
Dry season	180.3	44.3	4.21

Fig. 3. Fitting of the radio collar used in this study (Photo S. Clegg).

As reflected by home range and assuming linear movements between consecutive fixes, the study animal moved a greater total distance from December to March (404.2km) as compared to the early dry season between April and June (250.7km). There was also considerable variation in the distance that the study animal travelled per 24hrs over the duration of the study (mean = 3.5km ± 2.9km: range 36m-16,068m). The cheetah was active throughout the day and night, but travelled greatest distances between the hours of midnight and 04:00hrs, and again between midday and 16:00hrs. In contrast, the cheetah was apparently most sedentary between 16:00 and 20:00hrs (Fig. 3).

Discussion

Zimbabwe's cheetahs make an important contribution to the global metapopulation of this endangered species (Nowell & Jackson 1996). However, the need to evaluate the status of the species and threats to their survival in this country has become more urgent in light of the recent rapid changes in land use. This preliminary GPS study of a single adult male cheetah, believed to be the first for this species in Zimbabwe, demonstrates the value of this technique for gathering key information on behaviour and ranging patterns. Furthermore, the successful completion of this albeit limited pilot study suggests that more comprehensive work is feasible.

Results of this pilot study are constrained by lack of replication and its short duration. However, it is notable that the cheetah utilised an area greater in size than that covered by Malilangwe Estate, which included a nine-day excursion into the new settlement to the north and travelling a distance of 43km during this period. Discounting exploratory behaviour and the resulting outlying fixes, core home range was broadly comparable to those reported in other studies of this species in Zimbabwe (Purchase & du Toit 2000, Zank 1995) and in similar habitat elsewhere in east and southern Africa (Broomhall *et al.* 2003, Caro 1994, Mills & Biggs 1993).

Home ranges of carnivores may be influenced by a number of factors including social status and in particular, the abundance and the spatial and temporal distribution of prey species

(Stander 1991, Grigione *et al*. 2002). Indeed, the seasonal differences in home range of our study animal may well have been related to resource dispersion (Spong 2000), with the availability of permanent water within the study area resulting in a concentration of prey during the drier period from April to June.

Further work is needed to augment these findings, but if the movements of this animal prove to be typical for the species, conservation plans must take into account the large areas that cheetah may utilise in southern Zimbabwe and the potential for individuals to cross land use and ownership boundaries, as occurs in Namibia (Marker *et al*. 2003). The successful completion of this pilot GPS study on a single male cheetah paves the way for a more comprehensive investigation of the behavioural ecology of this species in the southern Lowveld of Zimbabwe. Together with complementary interview-based assessments of cheetah status, this information should contribute to the development of a strategic conservation plan for this endangered species.

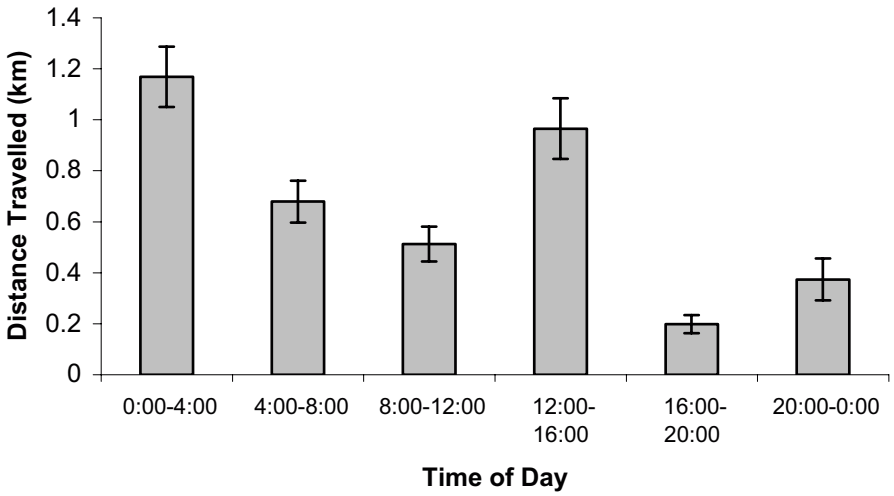

Fig. 4. Mean (±SE) distance travelled by an adult male cheetah throughout the day between 13 December 2003 and 15 June 2004.

Acknowledgements

The authors wish to thank Dr Gianetta Purchase and Dr Chris Foggin for their invaluable assistance and the Malilangwe Conservation Trust and its staff for logistical and technical support throughout the study period.

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