CHAPTER 11

GENERAL DISCUSSION

The aims of this project were to investigate the behavioural ecology of free-ranging caracals in the Kgalagadi Transfrontier Park, and to try to establish whether the caracals from the Park impacted on the small stock farming industry in Namibia. To accomplish these aims it was necessary to complete a number of parallel studies to investigate various components of caracal behaviour that might have a bearing on the impact of caracals on the small stock farming industry. The results from each component study will therefore now be briefly discussed.

Capture, collaring, care and release

To conduct any study that requires radio-telemetry, it is first necessary to capture the research animals. To ensure that such a study is successful it is essential that the research animals be released in the same or better condition to that in which they were captured.

The two factors that have the greatest bearing on the success of any wild predator capture programme are the efficiency and selectivity of trapping (Boddicker 1999). To accomplish these goals in relation to the capture of caracals it was necessary to use box traps that were specifically designed for caracals. Therefore the cages that were used here were of a size that ensured that predators such as lions, brown hyaenas and spotted hyaenas could not enter the traps. To prevent smaller animals from tripping the caracal traps, the treadle can be set to release the trap door only after a specific pressure was applied (Boddicker 1999). However, this approach was not ideal because of the possibility of setting the treadle too coarsely and thus missing the capture of some caracals. Positioning the traps in areas of known caracal activity is the most effective method of improving the selectivity of such trapping.

Due to logistic, ecological and ethical considerations, live baits could not be used in the present study. Several combinations of bait and lure were therefore used in this study, the most effective and most frequently used bait and lure combination being fresh frozen chicken bait in conjunction with a shiny lure of tinfoil.

The low, (1.4 %) trapping success rate achieved in this study, compares well with that of previous studies on caracal (Stuart 1982, Norton & Lawson 1985, Moolman 1986, Avenant & Nel 1998). It emphasises the fact that caracals are inherently difficult to capture alive. The best way to improve the rate of capture is to saturate the study area with box traps. The only proviso is that each cage trap must be checked, cleared and reset on a daily basis.

To fit caracals with radio-collars and to measure and weigh them, it is necessary to immobilise them (Brand 1993). Of the methods that are available, the most effective and humane one to administer the immobilising drugs to a captured caracal was by physically restraining the animal with a crush plate that is inserted into the cage, before administering the drugs with a hand-held syringe.

McKenzie & Burroughs (1993) suggested that caracals be immobilised with a dose of 3 to 4 mg of Zoletil per kg of body mass. It was found that under field conditions it was preferable to prepare a standard dose of 50 mg of Zoletil for the immobilisation of wild caracals in box traps. All caracals captured were successfully immobilised with this dose, and no top-up dose was required whilst working on any of the animals. The estimation of body mass upon which to base the dose of Zoletil caused unnecessary stress to the captive animals and was often found to be inaccurate. Therefore it was discarded as an option.

To ensure that caracals remain cool whilst recovering from the narcosis, they were placed in the box traps in a cool, shaded place for the duration of their recovery. Once the caracals had recovered fully, the box traps were opened and the animals were released.

Range use by the caracal in the Kgalagadi Transfrontier Park

The ranges of the radio-collared caracals varied greatly. A female and two male caracals generated sufficient data to allow meaningful statistical analyses of the results. The range of male 1 was larger than that of male 2. It is likely that this discrepancy is due to male 1 being a dominant adult whose range encompasses the ranges of a number of females, whereas male 2 was a young subdominant animal. The range of female 1 was smaller than that of either male 1 or male 2. These results agree with the theory that female predators generally have ranges that are limited by the availability of prey and refuge sites, whereas males have range sizes that are dictated by their dominance status and the distribution of females (Sandell 1989). Two other caracals were collared and estimates of their range sizes were based on the available data. However, due to the small number of data points for each of these individuals, the ranges are not considered reliable. Male 3 was a young caracal that was tracked over a considerable distance before being killed in Namibia, probably while dispersing from his natal range. Female 2 was an older caracal that died of natural causes after having been collared for a month. During the period for which she was collared she remained in the vicinity of the Nu Quap windmill, in the interior of the Kgalagadi Transfrontier Park.

The ranges of the caracals in the Kgalagadi Transfrontier Park are larger than those that were found for caracals in other southern African studies (Stuart 1982, Norton & Lawson 1984, Moolman 1986, Avenant & Nel 1998). Bothma & Le Riche (1994) calculated the range size of a single male caracal in the southern Kalahari at 308 km^2, and in Saudi Arabia a single male caracal had a range of 1116 km^2 (Van Heezik & Seddon 1998). It is clear from these results and comparisons that caracal range sizes increase with increased aridity and reduced prey availability.

Habitat selection

The contribution of dune crests, dune slopes and dune streets to the Shrubby Kalahari Dune Bushveld (Low & Rebelo 1996) was calculated with the non-mapping method of Marcum & Loftsgaarden (1980). It was clear that caracals preferentially used the dune crests and dune slopes, probably because the elevation of the dune crests and slopes provides vantage points from which caracals can locate prey and other predators (Leyhausen 1979, Bothma & Le Riche 1989).

The suitability of the habitat for hunting seems to be a driving force behind the habitat selection of a caracal. A high density of *Rhigozum trichotomum* bushes, and of the annual grass *Schmidtia kalihariensis* that occur in these dune streets, and it inhibits the vision and movement of caracals in the dune streets. Caracals may also avoid areas of high *Schmidtia kalihariensis* density because the acidic exudates that this grass produces affects the animals negatively (Van Rooyen 2001).

Various authors have suggested that caracals prefer habitats that support large prey populations (Moolman 1986, Van Heezik & Seddon 1998). Preference for dune slopes is probably due to rodents occurring in higher densities there than on dune crests (Nel *et al.* 1984). The southwest facing dune slopes are generally steeper than the northeast facing ones (Van der Walt & Le Riche 1999). The sheer nature of the southwest facing slopes may inhibit caracal movements. Rodents seldom build burrows on southwest facing dune slopes because the sand there is less compact than elsewhere and the burrows collapse easily (Nel pers. comm.)[1]. The combination of these factors probably creates a habitat preference by the caracals for the northeast facing dune slopes.

The method that was used for detecting plant associations and their preferences by caracals for various activities has limitations, especially when caracals utilise plant species that are not recorded in a step-point transect that was used to collect the base-line plant frequency data. However, caracals do utilise certain plant species preferentially when performing certain types of behaviour.

Hunting behaviour

All hunts consist of a sequence of behavioural components that aim to kill prey. There are six basic behavioural components (crawl, stalk, crouch, take-off, chase, pounce) that could possibly be included in a hunt ending in a kill. There is no specific sequence or frequency of these behavioural components that comprise a hunt. Therefore the hunting behaviour of a caracal is highly adaptable and variable.

Moolman (1986) identified two separate strategies that are used by a caracal when hunting. The most frequently used one involved a caracal stalking the prey to within

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5 m, and then chasing it. A less frequently used tactic was hunting from an ambush. In the Kgalagadi Transfrontier Park, caracals tended to ambush their prey more often than stalking until close to them. Therefore stalking is the less frequently used tactic while hunting.

The hunting success of the caracal in the Kgalagadi Transfrontier Park is lower than that of other felids there (Eloff 1984, Bothma & Le Riche 1984). This may be due, in part, to the strict protocol that was used in the present study to determine whether a hunt was successful or not. When no visible evidence of a kill was found, the hunt was considered to have been unsuccessful. In the case of small prey, this might underestimate the hunting success achieved because caracals sometimes eat such an entire prey animal without disembowelling it. The success achieved by caracals when hunting large prey is similar to that recorded for leopard by Bothma & Le Riche (1984). It is probable that the distribution and abundance of prey limit the hunting success of caracal in the Kgalagadi Transfrontier Park. Therefore it seems that a high level of energy expenditure is required per unit of energy gained for a caracal to survive.

A hunting model was developed that was based on the differential likelihood of particular behavioural components resulting in a kill. It was hypothesised that hunting components should occur in a specific sequence to optimise hunting success. From the data analysis, it seems that the most successful strategy consists of five components, starting with a stalk, and then followed in sequence by a crouch, a take-off, a chase and finally a pounce. There are no restrictions to the number of repetitions of the behavioural components in a hunt, nor to the sequence in which they are performed. However, the model confirms that a logical sequence of goal-orientated behavioural components has the best chance of resulting in a kill.

Caracals in the Kgalagadi Transfrontier Park adopt similar methods to kill prey as reported elsewhere. They subdue large prey by pouncing on the prey and applying a non-fatal nape bite, followed by a killing throat bite to suffocate the prey. This is similar to the strategy that is applied by other large felids in Africa (Estes 1995). It is likely that caracals in the Kgalagadi Transfrontier Park use the same method to subdue small prey as was recorded in other studies (Grobler 1981, Stuart 1981, 1982, Moolman 1986, Stuart & Hickman 1991).

As in other studies (Grobler 1981, Stuart 1981, 1982, Moolman 1986, Stuart & Hickman 1991) caracals in the present study usually returned to large kills for a second feeding bout. This tendency was even observed in the vicinity of the Namibian border where the farmers often persecute the caracals. It is likely that in prey-poor environments caracals are found to return to their kills, even in areas of human activity.

Caracals cached the remains of larger kills under dense bushes, as was described by Bothma & Le Riche (1986) for leopards. However, caracals were never observed to cache kills in trees in the present study. Caracals often carried kills from the killing site to areas of more dense cover. This was probably done to prevent other predators spotting and competing for the kills.

Prey selection

The analysis of the diet of a predator should be representative of the diet of the population in that area. This means that the sample analysed should be large enough to include all possible prey. This part of the study was based on a sample of 116 scats, which is considered to be sufficient to give a reliable first order indication of the diet of caracals in the Kgalagadi Transfrontier Park. Rodents were the most abundant prey item for caracals in the present study, and they probably play a more significant role in the diet of caracals in the Kgalagadi Transfrontier Park than elsewhere in South Africa because of the low density of alternative prey (Avenant & Nel 1997). The tendency of using a high proportion of rodents was also observed for a single male caracal in Saudi Arabia (Van Heezik & Seddon 1998).

Springhares are the single most important prey item in the diet of caracals in the Kgalagadi Transfrontier Park. Although they are rodent too, they can be separated from the other rodent prey because of their large body size and concomitant high nutritional value to caracals.

Carnivores form a significant proportion of the diet of caracals in the Kgalagadi Transfrontier Park. The contribution of carnivores to the diet of caracals in the present study is higher than that recorded in other studies (Grobler 1981, Moolman 1986, Palmer & Fairall 1988, Stuart & Hickman 1991). It seems that the carnivores in the diet of caracals in the present study fill the medium to large prey category that is usually filled by small artiodactyls in other habitat types.

Predation on diurnal prey indicates that the caracals in the Kgalagadi Transfrontier Park display some level of diurnal activity. This supports the conclusions of Avenant & Nel (1998).

Wool from domestic sheep was found in eight of the 116 scats. Most (75 %) of the scats that contained wool were found in the cold season. It appears that caracal prey more upon domestic stock in the cold season when the abundance of natural prey is relatively low (Begg 2001) and the domestic stock are lambing to create a temporary potential prey peak.

Birds contribute less to the diet of caracal in the Kgalagadi Transfrontier Park than in the West Coast National Park (Avenant & Nel 1997). This low utilisation of avian prey is surprising because various birds, including the Kori bustards and korhaans that occur within the present study area, were thought to be ideal prey for a caracal.

Invertebrates do not contribute significantly to the diet of the caracal, due to their low individual biomass. Nevertheless coleopteran remains were found in a high proportion of the scats in the present study. This supports the findings of Palmer & Fairall (1988) that insects do contribute to the diet of caracals.

Caracals generally consume vegetable matter accidentally. The majority of the vegetable matter that was recovered from scats in the present study included grass, twigs and seeds. No scats that only contained plant material were found. No conclusive reason for the ingestion of plant material has been proposed. Most of the consumption is likely to be accidental. Tsamma melon seeds were found in three (2.6 %) of the scats. This confirms that caracals, like many other carnivores inhabiting this environment, do eat tsamma melons to supplement their moisture intake (Eloff 1984, Mills 1990, Bothma & Le Riche 1994).

Possible optimal foraging for Brant's whistling rats

It seems that the caracals display a level of optimal foraging when hunting for Brant's whistling rats in the hot season. In the cold season there is no evidence of optimal foraging. This is probably due to low relative abundance of Brant's whistling rats during the cold season. Caracals therefore follow a random search pattern in terms of Brant's whistling rats in the cold season, but in the hot season they follow paths that include a relatively high number of Brant's whistling rat colonies as part of optimal foraging.

The effect of small stock farming in Namibia on caracal density in the neighbouring Kgalagadi Transfrontier Park

Spoor density is an accurate index of animal density (Litvaitis *et al.* 1985, Smallwood & Fitzhugh 1994, Stander 1998, Jacomo & Diniz-Filho 2003). To determine whether caracals were actively moving on to Namibian small stock farms from the park, it was necessary to monitor whether the density of caracals in the interior of the Kgalagadi Transfrontier Park was identical with that along the Park's border with Namibia. If there were a cline of increasing spoor density from the interior towards the Namibian border, it would indicate that caracals were moving towards the stock farms.

Climatic factors and ground conditions influence the detectability of spoor along a track (Silveira *et al.* 2003). Provided that the detectability of spoor remains constant in all areas of the survey, the same level of error can be expected (Burnham & Anderson 1984). Hence, the error can be factored into the estimation of animal density.

It appears that in the hot season there is a low density of caracal spoor along the Namibian border in comparison with the interior of the Kgalagadi Transfrontier Park. In the cold season the spoor density in the interior and along the border are the same. Therefore it appears that caracals actively avoid the areas along the Namibian border in the hot season. However, in the cold season, when natural prey is more limiting, caracals utilise the areas along the Namibian border to the same extent as they use the interior of the park.

Because many authors feel that spoor counts are only useful for detecting moderate to large changes in population density (Kendall *et al.* 1992, Beier & Cunningham 1996, Strayer 1999) it is clear that there is a change in caracal density in the vicinity of the Namibian border between the hot and cold seasons. This further substantiates the theory that caracals move across the Namibian border more in the cold season when the abundance of natural prey is relatively low (Begg 2001) and the domestic stock are lambing to create a temporary potential prey peak.

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