CHAPTER 9

POSSIBLE OPTIMAL FORAGING FOR BRANT'S WHISTLING RATS BY THE CARACAL IN THE KGALAGADI TRANSFRONTIER PARK

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Optimal foraging in caracals has never been substantiated. The foraging pattern relative to a common prey animal can give an insight into the optimality of hunting behaviour. Foraging behaviour in caracals relative to Brant's whistling rats was investigated in the southern Kalahari. It showed that in the cold season no optimal foraging for these rats occurred, but in the hot season it did occur.

Keywords : Caracal, optimal foraging, Brant's whistling rat, Kalahari

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Little is known about optimal foraging behaviour in carnivores. Several attempts have been made to test the optimal foraging theory for predators consuming sedentary prey (Brown *et al.* 1999). Here, Brant's whistling rat *Parotomys brantsii*, a common prey of the caracal *Caracal caracal*, is used as a measure of optimal foraging in caracals in the semi-arid savanna environment of the Kgalagadi Transfrontier Park.

Traditionally it is assumed that natural selection dictates that animals have to optimise their behavioural patterns to ensure their survival (Ollason & Lamb 1995), but the currently accepted view is that optimality is merely a convenient framework within which to describe animal behaviour (Krebs *et al.* 1984). In predators, optimal foraging can be described as minimising the total path length required to survey areas of varying prey density so as to maximise hunting opportunities (Gelenbe *et al.* 1997). Stated differently, predators select routes that maximise their opportunities of encountering prey that are suitable for hunting.

Brant's whistling rats were chosen in this study because they are an abundant prey resource and they were found to contribute to the diet of caracals in the southern Kalahari (Melville *et al.* 2004). Brant's whistling rats contributed 11.6 % of the total number prey items found in caracal scats (Table 1), with no apparent seasonal variation.

To investigate whether caracals in the Kgalagadi Transfrontier Park adopted an optimal search strategy for Brant's whistling rats, the likelihood of encountering Brant's whistling rat colonies if moving randomly, was compared with the frequency in which caracals passed close to or through Brant's whistling rat colonies while foraging.

To estimate the likelihood of encountering Brant's whistling rat colonies, a vehicle was used to survey 20 straight-line randomly spaced transects of 10 km each in the study area. Ten transects were surveyed in the hot season (October to March) and 10 in the cold season (April to September). Observations on the presence or absence of Brant's whistling rat colonies were made at 0.5 km intervals along the length of each transect. A total of 400 observations were made, of which 200 were made in the hot season and 200 in the cold season.

To establish whether the observed rat colonies were occupied, each colony within a 10 m radius of the vehicle was checked for evidence of fresh rat activity. If no colony was

Table 1: *The incidence of active Brant's whistling rat colonies at 0.5 km intervals along randomly chosen transects and on caracal spoor in the Kgalagadi Transfrontier Park from June 2000 to August 2002.*

Item	Cold season		Hot season		Total	
	Present	Absent	Present	Absent	Present	Absent
Transects	158	177	128	74	286	251
Spoor	112	88	108	92	220	180
Total	270	265	236	166	506	431

present, or if there was no evidence of current activity in a colony, it was recorded as being inactive. This survey provided baseline data of the expected occurrence of active Brant's whistling rat colonies in the study area. The incidence of active Brant's whistling rat colonies along known movement paths of the caracals, were then compared with these baseline data.

The spoor-tracking method of Bothma & Le Riche (1984), Eloff (1984) and Stander *et al.* (1997) was used to track caracal movements. To determine a comparable frequency of occurrence of rat colonies along the caracal movement paths, the same observations were made on the spoor-tracking paths of caracals as were done for the baseline data. Therefore, observations of the occurrence of active Brant's whistling rat colonies were made every 0.5 km along each set of caracal tracks. This resulted in a total of 537 observations, 335 of which were in the cold season and 202 in the hot season.

The data were transformed to give those obtained from surveying the random transects and those obtained while spoor-tracking an equal weighting. This was done to ensure that both the data sets contributed equal proportions to the combined data set. This data transformation was done in four stages:

- The sum of all the observations from the transects and the spoor-tracking was calculated first.
- This total number of observations was then divided by the number of observations from the transects and from the spoor individually,
- The results from the above calculations were then multiplied by 0.5 to give an applicable ratio for both the transect and the spoor data.

- The total number of observations for the spoor tracking data and the transect data were then multiplied by the applicable ratio from the above process.

The above transformation ensured that the straight-line transect survey data and that of the spoor-tracking data contributed equally to the total number of observations in the data set. The transformation of the data also improved the comparability of the component data sets.

The CATMOD procedure of SAS (1999) was then applied to the transformed data. Logit modelling was then applied to determine whether the odds ratio of encountering a Brant's whistling rat colony was greater while tracking caracal spoor than on the randomly selected control transects. The results of this procedure generated confidence intervals at the 95 % level. When analysed for the whole year (df = 1, confidence interval [0.7, 1.22], $P = 0.57$) and for the cold season only (df = 1, confidence interval [0.5, 1.08], $P = 0.12$) there was no significant difference between the chances of encountering a Brant's whistling rat colony on the control transects or while tracking from spoor. However, for the hot season (df = 1, confidence interval [1.30, 3.38], $P = 0.0023$) there was a significantly higher likelihood of finding Brant's whistling rat colonies along the caracal spoor than on the control transects.

These results indicate that during the cold season, caracals do not forage optimally with regard to Brant's whistling rats. However, in the hot season they do seem to follow paths that include a high incidence of Brant's whistling rat colonies. This implies that a caracal may have a tendency to optimise its movements in terms of search time, encounter rate and energy expenditure (Sunquist & Sunquist 1989) in relation to Brant's whistling rat colonies in the hot season, and hence to optimise the number of opportunities to hunt these rats then.

It seems that caracals follow different foraging strategies for Brant's whistling rats seasonally. In the cold season when Brant's whistling rats are less abundant, caracals may well employ a random search strategy. However, in the hot season when these rats are more abundant and there is more overlap between their diurnal and nocturnal activity patterns (Nel & Rautenbach 1974; Skinner & Smithers 1990), caracals seem to choose paths that include a high number of Brant's whistling rat colonies.

Caracals probably optimise their foraging strategy based on the prevalence of other food resources too (Table 2). However, to substantiate this it would be necessary to investigate the optimality of foraging behaviour in caracals relative to other prey individually. It would also be necessary to establish whether optimal foraging by caracals is species-specific, or whether it includes their entire prey spectrum, and whether any such selection is based on the variation in seasonal abundance of the total prey resources.

References

BOTHMA, J. DU P. & LE RICHE, E.A.N. 1984. Aspects of the ecology and the behaviour of the leopard *Panthera pardus* in the Kalahari desert. Supplement to *Koedoe* 1984: 259-279.

BROWN, J.S., LAUNDRE, J.W. & GURUNG, M. 1999. The ecology of fear: Optimal foraging, game theory, and trophic interactions. *Journal of Mammalogy* 80 (2): 385-399

ELOFF, F.C. 1984. Food ecology of the Kalahari *Panthera leo vernayi.* Supplement to *Koedoe* 1984: 249-258.

Table 2: *The seasonal occurrence of Brant's whistling rat remains in caracal scats in the Kgalagadi Transfrontier Parkfrom June 2000 to August 2002*.

Prey	Hot season		Cold season		Total	
	Incidence	Percentage	Incidence	Percentage	Incidence	Percentage
Brant's whistling rat	7	11.5	19	11.6	26	11.6
Other	54	88.5	145	88.4	199	88.4
Total	61	100.0	164	100.0	225	100.0

GELENBE, E., SCHMAJUK, N., STADDON, J. & REIF, J. 1997. Autonomous search by robots and animals: a survey. *Robotics and Autonomous Systems* 22: 23 – 34.

KREBS, R.J., STEPHENS, D.W. & SUTHERLAND, W.J. 1984. Perspectives in optimal foraging theory. In: *Perspectives in ornithology,* (ed) Clark, G.A., Cambridge University Press, Cambridge.

MELVILLE, H.I.A.S., BOTHMA, J. DU P. & MILLS, M.G.L. 2004. Prey selection by caracal in the Kgalagadi Transfrontier Park. *South African Journal of Wildlife Research* 34(1): 67-75.

NEL, J.A.J. & RAUTENBACH, I.L. 1974. Notes on the activity patterns, food and feeding behaviour of *Parotomys brantsii* (Smith, 1840). *Mammalia* 38: 7-15.

OLLASON, J.G. & LAMB, A.E. 1995. The meaninglessness of foraging behaviour. In: *Perspectives in ethology, volume 2 : Behavioural design*. (ed). Thompson, N.S. Plenum Press, New York.

SAS Institute Inc. 1999. *SAS/ STAT® Users guide*, version 8. SAS Institute Inc. Cary

SKINNER, J.D. & SMITHERS, R.H.N. 1990. *Mammals of the southern African subregion.* University of Pretoria, Pretoria.

STANDER, P.E., GHAU, II., TSISABA, D., ǂOMA, II. & I UI, I. 1997. Tracking and the interpretation of spoor: a scientifically sound method in ecology. *Journal of the Zoological Society, London* 242: 329-341.

SUNQUIST, M.E. & SUNQUIST, F.C. 1989. Ecological constraints on predation by large felids. In : *Carnivore behavior, ecology, and evolution*. (ed) J.L. Gittleman Cornell University Press, Ithaca.