Short Communications

Diet of spotted hyaenas in some mesic and arid southern African game reserves adjoining farmland

J.D. Skinner*, P.J. Funston, R.J. van Aarde, G. van Dyk and M.A. Haupt
Mammal Research Institute, University of Pretoria, Pretoria, 0002 Republic of South Africa

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Species composition of prey consumed by spotted hyaenas *Crocuta crocuta* in three divergent areas in southern Africa was determined by scat analyses. The larger abundant antelopes predominated in the diet and their occurrence in the diet was apparently directly related to the availability of the prey within the hyaena foraging areas. In Mkuzi Game Reserve and the Namib Naukluft National Park, hyaenas coexist with only one other large predator. In Umfolozi Game Reserve, where hyaenas coexist with four other large predators, a greater variety of prey was taken. Scat weight in desert-dwelling hyaenas was twice that of those from more mesic areas, which may be an adaptation to restricted water intake. The incidence of domestic livestock in the diet was meagre, probably the result of collecting scats only from latrines within the game reserves.

Die spesies-samestelling van prooi verbruik deur gevlekte hiënas *Crocuta crocuta* in drie verskillende gebiede in Suidelike Afrika is bepaal deur faeces-analise. Die groter meer volop wildsbokke het die dieet gedomineer en die voorkoms in dieet toon 'n direkte verwantskap met beskikbaarheid van prooi in hiëna-jaggebiede. Hiënas deel Mkuzi Wildtuin en die Namib Naukluft Nasionale Park met slegs een ander groot roofdier terwyl vier ander groot roofdiere Umfolozi Wildtuin met hiënas deel, wat lei tot groter variasie in prooi-items. Faeces-massa van woestynlewende hiënas was twee keer meer as dié van hiënas in meer mesiese gebiede wat waarskynlik 'n aanpassing is vir beperkte water inname. Die voorkoms van plaasdiere in die dieet was baie laag, maar dit is heel waarskynlik as gevolg van faeces-versameling slegs binne die wildtuine.

Keywords: Food, predation, spotted hyaena

* To whom correspondence should be addressed

Spotted hyaenas *Crocuta crocuta* are efficient hunters and scavengers (Kruuk 1972; Tilson, von Blottnitz & Henschel 1980; Henschel & Skinner 1990; Mills 1990). During 1989 short-term studies on *C. crocuta* were undertaken in Umfolozi (31°50′E / 28°25′S) and Mkuzi (32°13′E / 27°36′S) Game Reserves in mesic Natal, and a study area of 1 300 km^2 within the vast Namib Naukluft National Park (area 2515 km^2 16°E 26°S) in arid Namibia. Diet was ascertained by identifying faecal hairs following Keogh (1983) and Buys & Keogh (1984). Spotted hyaenas produce distinctive faecal pellets in latrines which are easily identified. Two hundred and forty scats were collected in Umfolozi, 190 scats and 16 regurgitations in Mkuzi and 119 scats in the Namib.

In Mkuzi the mean group size of foraging hyaenas estimated from spoor analysis was 1,4 ± 0,68 (n = 113) and the population estimate [from call-up and baiting after (Whateley 1981)] was 38 individuals, and the density estimate 0,13 hyaenas/km^2. Clan size was estimated at between six and seven individuals. In Umfolozi Game Reserve, Whateley (1981) gives the mean group size of hyaenas at bait stations as 1,6, the population estimate (from call-up and baiting) as 161 individuals, and a density estimate of 0,36/km^2. Clan size was estimated at 14 individuals. In the Namib Naukluft National Park hyaenas usually foraged alone (n = 9) but groups comprising two adults were seen twice. Only one clan comprising three adults, one subadult and one young was observed in the study area. Clan size further north along the dry Kuiseb riverbed was recorded at 5,6 (n = 3) by Tilson *et al.* (1980).

Portions of the samples from Umfolozi, Mkuzi and the Namib were rejected because insufficient hair could be extracted from the scat (Table 1). There was a significant difference (p < 0,01 t test) between the mean mass of dried scats from Mkuzi and those from the Namib (Table 1). Previous results from 200 km further south in the Namib provided an average scat mass very similar to that found in the present study (Table 1). Mkuzi scats weighed significantly less than those from Kruger National Park (p < 0,05 t test) (Table 1). The mass of scats was not recorded from the Umfolozi Game Reserve samples. This is probably not related to the live weights of the hyaenas, although our results are meagre; one female from Mkuzi weighed 65 kg and one male and one female from the Namib weighed 52 kg and 56 kg respectively. Male hyaenas from Umfolozi weighed 66,6 kg (n = 8) *cf.* 70,0 kg (n = 6) for females (Whateley 1980) and males from the Kruger Park weighed 62,5 kg (n = 11) *cf.* 68,2 kg (n = 9) for females (Henschel 1986).

Another study, although on herbivores, has shown that as one would expect there is a significant positive correlation between body mass and faecal pellet mass (Coe & Carr 1983). The reverse apparently occurs in hyaenas from the Namib region. The heavier scats of smaller hyaenas may be an adaptation to restricted water intake; the passage of faeces through the colon may be delayed to allow for maximum water resorption, therefore, fewer scats are

Table 1 Percentage of rejected scats and mean mass of dried scats in the present and in other studies

	Umfolozi n = 162	Mkuzi n = 190	Namib n = 129
Rejected because of insufficient hair	20,6%	17,4%	8,8%
Mean mass of dried scats	–	81,5 ± 23,9 g	166,3 ± 70,6 g
Other references for mean scat dry mass	96,7 ± 62,2 g – Kruger National Park (Henschel & Skinner 1990)		
	160,9 ± 21,7 g — Namib 200 km south of present study (Skinner & Van Aarde 1981)		

Table 2 Animals consumed by spotted hyaenas in game reserves in Natal and the Namib desert in 1989 as identified from remains found in scats. N = number of scats and D = prey density estimate in individuals / km^2 based on T. Morley (pers. comm.) for Umfolozi Game Reserve, P. Goodman (pers. comm.) for Mkuzi Game Reserve population estimates

	Umfolozi n = 162			Mkuzi n = 190			Namib n = 129		
Species	N	%	D	N	%	D	N	%	D
Impala *Aepyceros melampus*	40	24,7	11,3	50	31,8	21	–	–	
Nyala *Tragelaphus angasii*	21	12,9	5,1	63	40,1	11	–	–	
Kudu *Tragelaphus strepsiceros*	14	8,6	4,1	5	3,2	2	–	–	
Bushbuck *Tragelaphus scriptus*	4	2,5		–	–		–	–	
Eland *Taurotragus oryx*	–	–		4	2,5		–	–	
Grey duiker *Silvicapra grimmia*	2	1,2	2,3	15	9,5	2	–	–	
Red duiker *Cephalophus natalensis*	–	–		2	1,3	1	–	–	
Klipspringer *Oreotragus oreotragus*	1	0,6		–	–		1	0,8	
Mountain reedbuck *Redunca fulvorufula*	–	–		1	0,6		–	–	
Suni *Neotragus moschatus*	–	–		3	1,9		–	–	
Steenbok *Raphicerus campestris*	5	3,1		2	1,3		–	–	
Blue wildebeest *Connochaetes taurinus*	6	3,7	2,7	–	–		–	–	
Waterbuck *Kobus ellipsiprymnus*	4	2,5	0,6	–	–		–	–	
Goat *Capra hircus*	3	1,9		–	–		1	0,8	
Burchell's zebra *Equus burchelli*	9	5,6	3,7	–	–	2	–	–	
Warthog *Phacochoerus aethiopicus*	17	10,5	1,2	13	8,3	2	–	–	
Bushpig *Potamochoerus porcus*	2	1,2		9	5,7		–	–	
Gemsbok *Oryx gazella*	–	–		–	–		80	67,2	1–5
Springbok *Antidorcas marsupialis*	–	–		–	–		15	12,6	1–2
Buffalo *Syncerus caffer*	8	4,9		–	–		–	–	
Cattle *Bos indicus*	4	2,5		–	–		–	–	
Cane rat *Thryonomus swinderianus*	9	5,6		26	16,5		–	–	
Ground squirrel *Xerus inauris*	–	–		–	–		2	1,7	
Porcupine *Hystrix africaeaustralis*	–	–		–	–		2	1,7	
Rock dassie *Procavia capensis*	–	–		–	–		1	0,8	
Scrub hare *Lepus saxatilis*	2	1,2		–	–		–	–	
Aardvark *Orycteropus afer*	1	0,6		–	–		–	–	
Striped polecat *Ictonyx striatus*	–	–		–	–		1	0,8	
Yellow mongoose *Cynictis penicillata*	–	–		–	–		5	4,2	
Banded mongoose *Mungos mungo*	1	0,6		1	0,6		–	–	
Large spotted genet *Genetta tigrina*	–	–		2	1,3		–	–	
Baboon *Vulpes chama*	–	–		–	–		2	1,7	
Bateared fox *Otocyon megalotis*	–	–		–	–		4	3,4	
Aardwolf *Proteles cristatus*	–	–		–	–		5	4,2	
Unidentifiable	9	5,6		8	3,2		–	–	

deposited. Or it may be related to the interval between fast and feast, this being greater in Namib hyaenas. Bowel movement is stimulated by ingestion which is probably less frequent in desert hyaenas.

The results of the analyses of identifiable contents of the scats are presented in Table 2.

Sixteen regurgitations from Mkuzi hyaenas each contained only one hair type, eight with impala *Aepyceros melampus* and seven with nyala *Tragelaphus angasii* hair.

In Umfolozi lions *Panthera leo*, leopards *P. pardus*, wild dogs *Lycaon pictus*, and cheetahs *Acinonyx jubatus* are present, while in Mkuzi and the Namib, leopards facilitate scavenging. Therefore, it is presumed that hyaenas in at least Mkuzi Game Reserve and the Namib Naukluft National Park are important predators, but take carrion when available and that they probably fulfil a predator/scavenger role in Umfolozi Game Reserve. Both Bearder (1977) and Henschel & Skinner (1990) found that a reliable indication of major prey species consumed could be obtained from scat analyses, despite the inability to distinguish scavenged or hunted prey. In all three reserves, spotted hyaenas were found to consume the medium to larger (up to 240 kg) more plentiful ungulates, impala and nyala in the mesic eastern part of the subcontinent and gemsbok and springbok in the arid west (Table 2). The data presented relate to the prey species consumed by the spotted hyaena in the various reserves and make no attempt to distinguish between hunted or scavenged prey. Unfortunately it was impossible to determine the seasonal variation in prey selection by hyaenas as it was not possible to determine the age of the scats found in the latrines. Although hair from a scat contains enough information to identify the species of the animal, it contains no information on age, sex or size. Therefore, no further classification is possible.

Spotted hyaena scats were collected throughout Mkuzi and Umfolozi Game Reserves, both of which adjoin directly on land used for livestock farming operations. Hyaenas use latrines in order to mark their territories (Kruuk 1972) and it is unlikely that they would establish territories, and henceforth latrines, in areas densely populated by man where their continued presence would not be tolerated, if they were in search of domestic prey while foraging outside the reserves. The low incidence of scats containing hairs from domestic livestock is probably a true reflection of their proportion in the diet.

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References

BEARDER, S.K. 1977. Feeding habits of spotted hyaenas in a woodland habitat. *E. Afr. Wildl. J.* 15: 263–280.

BUYS, D. & KEOGH, HILLARY J. 1984. Notes on the microstructure of the hair of the Orycteropodidae, Elephantidae, Equidae, Suidae and Giraffidae. *S. Afr. J. Wildl. Res.* 14: 111–119.

COE, M.J. & CARR, R.D. 1983. The relationship between large ungulate body weight and faecal pellet weight. *Afr. J. Ecol.* 21: 165–174.

HENSCHEL, J.R. 1986. The socio-ecology of a spotted hyaena *Crocuta crocuta* clan in the Kruger National Park. D.Sc. thesis, University of Pretoria.

HENSCHEL, J.R. & SKINNER, J.D. 1990. The diet of spotted hyaenas *Crocuta crocuta* in the Kruger National Park. *Afr. J. Ecol.* 28: 69–82.

KEOGH, HILLARY J. 1983. A photographic reference system of the microstructure of the hair of southern African bovids. *S. Afr. J. Wildl. Res.* 13: 89–132.

KRUUK, H. 1972. The spotted hyaena: A study of predation and social behaviour, University Press, Chicago.

MILLS, M.G.L. 1990. Kalahari hyaenas. Unwin Hyman, London.

SKINNER, J.D. & VAN AARDE, R.J. 1981. The distribution and ecology of the brown hyaena *Hyaena brunnea* and spotted hyaena *Crocuta crocuta* in the central Namib desert. *Madoqua* 12: 231–239.

TILSON, R.L., VON BLOTTNITZ, F. & HENSCHEL, J.R. 1980. Prey selection by spotted hyaenas (*Crocuta crocuta*) in the Namib Desert. *Madoqua* 12: 41–49.

WHATELEY, A. 1980. Comparative body measurements of male and female spotted hyaenas from Natal. *Lammergeyer* 28: 40–43.

WHATELEY, A. 1981. Density and home range of spotted hyaenas in Umfolozi Game Reserve, Natal. *Lammergeyer* 31: 15–20.

Bait preferences of the rock elephant shrew

J.S. Du Toit *

Department of Mammalogy, National Museum, P.O. Box 266, Bloemfontein, 9300 Republic of South Africa

L.J. Fourie

Department of Zoology and Entomology, University of the Orange Free State, P.O. Box 339, Bloemfontein, 9300 Republic of South Africa

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Preferences of the rock elephant shrew *Elephantulus myurus* for three types of bait were ascertained under semi-free-ranging conditions in the central Orange Free State. The addition of insect components to the traditional bait (peanut butter and rolled oats), greatly increased trapping success. For the best trapping results traps should be set selectively (near boulder piles, cracks and crevices) where the likelihood of catching elephant shrews seems high. Traps should also be baited in the afternoons and checked during the early mornings.

Voorkeure van die klipklaasneus *Elephantulus myurus* vir drie aastipes is onder gedeeltelike vrylewende toestande in die sentrale Oranje Vrystaat vasgestel. Daar is bevind dat die toevoeging van insekkomponente by die tradisionele aas (grondboontjiebotter en gerolde hawermout) die vangsukses grootliks verhoog. Die beste vangresultate word verkry deur die valle selektief (naby rotshope, krake en rotssplete), waar die moontlikheid om klaasneuse te vang die waarskynlikste is, te stel. Valle moet verkieslik in die middag gestel en in die vroeë oggende nagegaan word.

Keywords: Bait, capture, elephant shrew, field technique

* To whom correspondence should be addressed

Rock elephant shrews *Elephantulus myurus* are known to be difficult to trap. This forced certain earlier collectors to resort to the radical method of shooting them (Loveridge 1922). The importance of effective trapping methods to study various aspects of the ecology of elephant shrews is apparent. Various baits and combinations of baits have previously been tested, primarily on rodents (Beer 1964; Patric 1970; Dippenaar 1974; Willan 1986). There is, however, a great paucity of information on trapping methods and bait preferences for elephant shrews in particular. The natural diet of elephant shrews consists of insects and some plant material (Brown 1964; Churchfield 1987; Skinner & Smithers 1990). Theoretically it should be possible to trap them by using a large variety of baits. The purpose of this study was to investigate possible preferences of rock elephant shrews for various bait mixtures and to report on the results of a field-trapping programme using two different types of bait.

The study on bait preferences was conducted during January 1990. Two weeks prior to the commencement of the experiment eight *E. myurus* (four males and four females) were released in an enclosure (6 × 2 m) which simulated (rock piles and natural cover) their natural environment. All animals were toe clipped in such a way as to ensure individual identification. The ages of the shrews, based on their body mass (65,36 g; *S.E.* 0,96), were estimated to be more or less similar. Dog pellets (Epol Puppy Food Stage 1, South Africa) and water were provided *ad lib.* Preferences of elephant shrews for three dfferent baits were ascertained by using twelve galvanised live traps (Sherman-type: 250 × 80 × 750 mm). Bait composition and preparation was as follows: Bait A comprised peanut butter, lard and candle wax (1:1:1 by mass) melted together and mixed with rolled oats (two parts per mass); Bait B comprised peanut butter, rolled oats and sunflower oil (6:3:1 by mass); and Bait C was the same as Bait B, but with homogenized fresh cockroaches, *Periplaneta americana* (60 g/kg).

Table 1 Capture frequencies of *E. myurus* with different baits

Day	Capture frequencies		
	Bait A	Bait B	Bait C
1	1	4	3
	1	2	5
3	2	3	3
4	1	3	4
5	0	4	6
6	1	4	5
7	0	3	5
8	0	2	4
9	0	3	4
10	0	3	3
$\bar{x}$	0,6	3,1	4,2
S.E.	0,221	0,233	0,327

Bait A: peanut butter, lard and candle wax (1:1:1 by mass) melted together and mixed with rolled oats (two parts per mass)
Bait B: peanut butter, rolled oats and sunflower oil (6:3:1 by mass)
Bait C: the same as Bait B, but with homogenized fresh cockroaches, *Periplaneta americana* (60 g/kg)

The live traps were placed in groups of three (each trap containing a different bait) along the sides of the enclosure. The trapping success using the different baits was determined over a period of 10 days. Traps were checked on a daily basis at 08:00 and 17:00. The identity of the captured elephant shrew as well as the trap number and bait mixture was recorded. Traps were rebaited with the same bait mixtures after the removal of captured animals. All the traps were rebaited with freshly made bait mixtures on the fourth and seventh day.

The field-trapping programme was conducted between February 1989 and May of 1990 in the 2926Aa quarter-degree grid. A similar type of trap as previously mentioned was used and traps were set either selectively (near boulders, cracks or crevices), in line, or in a grid. Either Bait B or C was used. A summary of elephant shrew capture frequencies for the bait preference trial over a period of 10 days is given in Table 1. Statistical comparisons (Mann-Whitney, t test) between the groups showed that significantly ($p < 0,01$) more elephant shrews were caught with Baits B and C than A. Significantly ($p < 0,05$) more elephant shrews were also caught using Bait C than Bait B. More elephant shrews entered traps overnight or early morning than during the day ($p < 0,0001$). No statistically significant difference in bait selection between males and females was evident.

Results of the field-trapping programme are summarized in Table 2. The highest trapping success rate was obtained from the traps which were set selectively. On two of the three occasions when Bait C was used, more elephant shrews than Namaqua rock mice were captured (Table 2).

Various trapping methods have been used in the past in an attempt to capture elephant shrews alive. These methods included the use of bowstring snares (Brown 1964), long

Table 2 Trapping statistics of small mammals captured at various localities in the 2926Aa quarter grid during the period February 1989 to May 1990 (See Table 1 for details of baits used)

Month/Year	02/89	04/89	05/89	08/89	09/89	12/89	01/90	03/90	05/90
% of total capture									
E. myurus	25,00	37,93	35,00	31,58	35,71	25,00	41,67	54,05	73,08
A. namaquensis	75,00	62,07	65,00	68,42	64,29	65,00	58,33	45,95	26,92
R. pumilio	0,00	0,00	0,00	0,00	0,00	10,00	0,00	0,00	0,00
Trapping success (all animals) per day	5,44	13,18	25,00	7,04	3,68	4,76	4,90	3,78	2,65
Trapping success (*E. myurus*) per day	0,014	0,050	0,088	0,022	0,013	0,012	0,020	0,020	0,019
No. of traps	98	20	20	90	76	84	196	196	196
Positioning of traps	Line	Selective	Selective	Line	Line	Line	Grid	Grid	Grid
Trapping days	3	11	4	3	5	5	5	5	5
Bait used	B	B	B	B	B	B	C	C	C

nets and beaters (Van der Horst 1946; Brown 1964; Rankin 1965; Tripp 1972; Rathbun 1978, 1979), drop traps (Rathbun 1979; Rathbun, Beaman & Maliniak 1981) and Sherman live traps (Tripp 1972; Neal 1982; Woodall & Mackie 1987; Woodall & Currie 1989). Various types of bait have also been used. Tripp (1972) used sultanas, but only managed to capture large numbers of *Aethomys namaquensis* and *Mastomys natalensis*. A mixture of peanut butter, rolled oats, cheese spread, beef fat and meat extract was used by Jooste & Palmer (1982) in an attempt to capture a variety of rodents, shrews and elephant shrews. Overall trapping success/100 trapping periods (12 h each) obtained by the latter authors for *E. myurus, A. namaquensis, R. pumillio* and *P. natalensis* was 0,09 (n = 35), 0,78 (n = 307), 1,64 (n = 650), and 0,53 (n = 208), respectively. In most other studies the authors did not specify the type of bait used or trapping success for elephant shrews.

From the results presented it is evident that the trapping success of rock elephant shrews may be increased by the addition of insect components to a bait mixture of peanut butter and rolled oats. The high trapping success may result from a higher degree of attraction or lower occupation of traps by undesired species. Selective setting of traps at places where the likelihood of capturing rock elephant shrews seems high will further increase trapping success. Since elephant shrews are believed to be territorial, frequent shifts to new trapping sites are recommended in order to prevent the depletion of the resident population. For the best trapping results traps should be set during the late afternoons and checked during the early morning. Elephant shrews trapped in live traps during daylight may become hyperthermic and die, especially during hot summer months. During winter elephant shrews may also become hypothermic.

References

BEER, J.R. 1964. Bait preferences of some small mammals. *J. Mammal.* 45: 632–634.

BROWN, J.C. 1964. Observations on the elephant shrews (Macroscelididae) of equatorial Africa. *Proc. zool Soc. Lond.* 143: 103–119.

CHRUCHFIELD, S. 1987. A note on the diet of the rock elephant shrew, *Elephantulus myurus*, in Zimbabwe. *J. Zool., Lond.* 213: 743–745.

DIPPENAAR, N.J. 1974. Bait preference of *Rhabdomys pumilio. Zool. Afr.* 9: 90–92.

JOOSTE, J.F. & PALMER, N.G. 1982. The distribution and habitat preference of some small mammals in the Rolfontein Nature Reserve. *S. Afr. J. Wildl. Res.* 12: 26–35.

LOVERIDGE A. 1922. Notes on East African mammals collected 1920–1923. *Proc. zool. Soc. Lond.* 1923: 685–739.

NEAL, B.R. 1982. Reproductive ecology of the rufous elephant shrew, *Elephantulus rufescens* (Macroscelididae), in Kenya. *Z. Säugetierk.* 47: 65–71.

PATRIC, E.F. 1970. Bait preferences of small mammals. *J. Mammal.* 51: 179–182.

RANKIN, J.J. 1965. Notes on the ecology, capture and behaviour in captivity of the elephant shrew *Nasilio brachyrhynchus brachyrhynchus* (A. Smith). *Zool. Afr.* 1: 73–80.

RATHBUN, G.B. 1978. Evolution of the rump region in the golden-rumped elephant shrew. *Bul. Car. Mus. Nat. Hist.* 6: 11–19.

RATHBUN, G.B. 1979. The social structure and ecology of elephant-shrews. Advances in Ethology No. 20. Paul Parey, Berlin.

RATHBUN, G.B., BEAMAN, P. & MALINIAK, E. 1981. Capture, husbandry and breeding of Rufous elephant-shrews. *Intern. Zool. Yearb.* 21: 176–184.

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

TRIPP, H.R.H. 1972. Capture, laboratory care and breeding of elephant-shrews (Macroscelididae). *Lab. Anim.* 6: 213–224.

VAN DER HORST, C.J. 1946. Some remarks on the biology of reproduction in the female of *Elephantulus*, the holy animal of Set. *Trans. roy. Soc. S. Afr.* 31: 181–199.

WILLAN, K. 1986. Bait selection in laminate-toothed rats and other southern African small mammals. *Acta Theriol.* 31: 359–363.

WOODALL, P.F. & CURRIE, G.J. 1989. Food consumption, assimilation and rate of food passage in the Cape elephant shrew, *Elephantulus edwardii* (Macroscelidea: Macroscelidinae). *Comp. Biochem. Physiol.* 92: 75–79.

WOODALL, P.F. & MACKIE, R.I. 1987. Caecal size and function in the rock elephant shrew *Elephantulus myurus* (Insectivora, Macroscelididae) and the Namaqua rock mouse *Aethomys namaquensis* (Rodentia, Muridae). *Comp. Biochem. Physiol.* 87: 311–314.