Diet of serval *Felis serval* in a highland region of Natal

Jane M. Bowland * and M.R. Perrin

Department of Zoology and Entomology, University of Natal, P.O. Box 375, Pietermaritzburg, 3200 Republic of South Africa

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Serval *Felis serval* diet was determined using faecal analysis. A combination of quantification techniques best illustrated the relative importance of various prey species. Small mammals (Rodentia and Insectivora) accounted for 94% of prey item occurrences. *Otomys irroratus* was the most important prey species in terms of biomass and number. There was no evidence for servals eating lambs or other medium-sized mammals in the study area.

Die tierboskat *Felis serval* se dieet is deur middel van misanalises bepaal. 'n Kombinasie van kwantitatiewe tegnieke illustreer ten beste die relatiewe belangrikheid van verskeie prooispesies. Van die prooi-items kon 94% aan klein soogdiere (Rodentia en Insectivora) toegereken word. *Otomys irroratus* was die belangrikste prooispesie in terme van biomassa en getalle. Daar was geen getuienis daarvan dat tierboskatte skaaplammers of ander middel-grootte soogdiere in die studiegebied vreet nie.

* To whom correspondence should be addressed at: Department of Botany, University of Natal, P.O. Box 375, Pietermaritzburg, 3200 Republic of South Africa

Conservation biology and natural ecosystem functioning on farmland are becoming increasingly important as human population and economic pressures on reserves increase. The status of carnivores can often be used to indicate the dynamic balance within an ecosystem. Servals *Felis serval* occur throughout the Natal midlands and highlands in conservation areas and on farmland but come into conflict with farmers over suspected small stock predation. Serval diet has previously been described in detail only from wilderness areas in Zimbabwe (Smithers 1978) and Tanzania (Geertsema 1985), where they depend predominantly on small mammals. This study was undertaken to compare the diet of servals on farmland in South Africa with that of servals in wilderness areas in other regions, and to indicate the extent of predation on small stock by servals.

The study was undertaken in the Kamberg Nature Reserve and on adjacent farmland in the Kamberg area of Natal (29°21′ / 29°27′S; 29°38′ / 29°48′E). Sheep lambs were present on two farms and hares, common duikers, and mountain reedbuck occur in the region. Small mammals were abundant in wetlands (Bowland & Perrin 1993).

Methods

Faecal analysis was used to determine diet as scats were readily available. Scats were collected along paths, roads, and in long grass. They were stored in numbered paper bags with the date and location of collection recorded: each scat was dried at 60°C to constant mass for storage. Dry scats were softened in boiling water and 4% formalin, then macerated in a 1 mm mesh sieve under running water until clean. Teeth, jaw fragments, plant material, feathers, and any other identifiable remains were separated from the remainder of the scat, which was predominantly hair. Serval hairs resulting from grooming were removed from the scat for positive specific identification (Saunders 1963). All scats without serval hair were rejected.

Grass was re-dried at 60°C and weighed. Feathers and avian skeletal remains were used to identify birds as far as possible (G.L.Maclean, pers. comm. 1990). Teeth and jaws were used to identify small mammal remains to species using tooth alveoli patterns (Bowland & Bowland 1990) and a reference collection.

Hairs from scats were floated in a shallow dish and five clumps, each *ca* 0,1 g, were randomly picked as subsamples. The hairs in each subsample were identified using scale pattern, shape, and colour (Perrin & Campbell 1980; Keogh 1985). In five scats 10 hair subsamples were taken to confirm that each species present was recorded in the first five subsamples examined.

Cafeteria tests (Pinowski & Drodz 1975) were conducted with three servals to determine if there was any preference in prey species eaten or whether species were randomly chosen. Servals were each given a choice of three *Otomys irroratus*, three *Rhabdomys pumilio*, 5–6 *Myosorex varius* and half an unplucked adult chicken repeated for five nights. The amount of each food type eaten was recorded on a scale of 0–3, where 0 = 0% eaten, 1 = 1–30% eaten, 2 = 31–60% eaten and 3 = 61–100% eaten. The score for each food type was summed and divided by the number of nights the test ran.

Results of scat analysis were recorded using frequency of occurrence where the occurrence of a prey species in a scat was recorded as a percentage of the number of scats analysed (Scott 1941; Norton, Lawson, Henley & Avery 1986). The number of individuals of each prey type was recorded as a percentage of the total number of individuals to give relative per cent occurrence (Rowe-Rowe 1983). Percentage biomass ingested was calculated as follows:

$$\frac{\#\text{ of individuals of sp. } y \times \text{mean live mass of sp. } y \times 100}{\text{total biomass ingested}}$$

Frequency of occurrence and percentage biomass ingested were plotted on paired axes to show relative importance of the various prey types (Kruuk & Parish 1981; Maddock 1988).

Results

Most scats were collected during autumn and winter when invertebrate activity and rainfall were low and scats remained intact. Ninety of 211 scats were positively identified as serval scats. The rest were unidentified or came from other carnivores.

Grass was present in small quantities in nearly all scats, comprising on average 0,67% of the total scat mass.

Four prey categories were identified. Small mammals accounted for 93,5% of prey individuals (rodents 80% and Insectivora 13,5%). Birds constituted 5%, reptiles (order Squamata) 0,9% and insects (order Orthoptera) 0,7% (Table 2). No attempt was made to identify reptiles or insects beyond order because their low relative per cent occurrence indicated they were not an important component of the diet. Birds were identified as far as possible (Table 1). However, a large proportion could not be identified since feathers were too finely macerated or came from juveniles. An average mass was estimated for birds that were identified to family or genus (Maclean 1985) and a mean mass was used for the unidentified birds. This estimate was inaccurate because of the relatively large proportion of unidentified occurrences and the range of body mass.

Table 1 Birds identified from remains in serval scats (mean mass from Maclean 1985)

	Number of individuals	Mean mass (g)
Sarothrura sp	6	39,1
Alandidae/Montacillidae	3	44,0
Ortygospiza sp.	1	12,0
Estrilda astrild	1	8,4
Euplectes sp.	1	23,1
Cisticola sp.	2	13,4
Large bird*	1	700,0
Unidentified	7	75,8

* One scat contained feather quills from an unidentified large bird. It was assumed that this constituted one meal which, from captive studies, is a maximum of 700 g.

Mean biomass of all identified small mammal species was used to calculate biomass of the unidentified items in this group (Table 2). The mean mass of *R. pumilio* and *M. varius* prey was the sum of the products of number of scats collected in a season and mean mass of *R. pumilio* and *M. varius* trapped in the study area during that season (Bowland 1990), divided by total number of scats. For *O. irroratus*, *Tatera brantsii*, *Mus minutoides*, and *Dendromus melanotis* an overall mean mass of individuals caught in the study area was taken. Percentage biomass ingested of each small mammal species was calculated to give the relative contribution of each species to the small mammal component of the diet (Figure 1).

O. irroratus was the most important prey species (Figure 2), occurring in 94,4% of the scats analysed, and constituting over 60% of the total biomass consumed (Table 2). The second most important prey species was *R. pumilio*, then birds, contributing 5,6% of the biomass consumed. Flufftails (*Sarothrura* sp.) were the most frequently eaten birds (Table 1).

Cafeteria tests showed that servals chose *O. irroratus* before other food types. Their second choice was chicken, then *R. pumilio* and lastly *M. varius* (Table 3). *M. varius* were usually rejected and one serval never ate them.

No new prey items (small mammal species or other classes) were found after the 50th scat was analysed, when ordered according to date collected. The sample size of 90 scats was therefore an adequate representation of serval diet.

Discussion

Scat analysis is a convenient method for determining the diet of a secretive nocturnal animal, as it does not require sacrifice of the animal or direct observation of its feeding behaviour, and scats are often readily available. Scat analy-

Table 2 Contribution of various prey types/species to serval diet showing the results of different analysis techniques (n = 90)

	Frequency of occurrence		Number of individuals			Mass ingested		
Prey type	Actual	%	Actual	%	Mean mass (g)	Actual (g)	%	Source mean mass data
Otomys irroratus	85	94,4	155	35,6	126,5	19607,5	62,6	own data
Rhabdomys pumilio	68	75,6	134	30,7	35,7	4783,8	15,2	own data
Dasymus incomtus	9	10,0	10	2,3	106,8	1068,0	3,4	De Graaff 1981
Mastomys natalensis	12	13,3	20	4,6	58,0	1160,0	3,7	De Graaff 1981
Cryptomys hottentotus	9	10,0	9	2,1	126,5	1138,5	3,6	De Graaff 1981
Tatera brantsii	2	2,2	2	0,5	93,7	187,4	0,6	own data
Mus minutoides	5	5,6	6	1,4	8,4	50,4	0,2	own data
Dendromus melanotis	3	3,3	3	0,7	10,5	31,5	0,1	own data
Myosorex varius	37	41,1	55	12,6	11,9	654,5	2,1	own data
Amblysomas hottentotus	4	4,4	4	0,9	67,9	271,6	0,9	Kuyper 1979
Unidentified small mammal	9	10,0	9	2,1	72,7	654,7	2,1	calculated
Bird	21	23,3	22	5,0	75,8	1667,5	5,5	calc.Table 3
Reptile	4	4,4	4	0,9				
Insect	3	3,3	3	0,7				

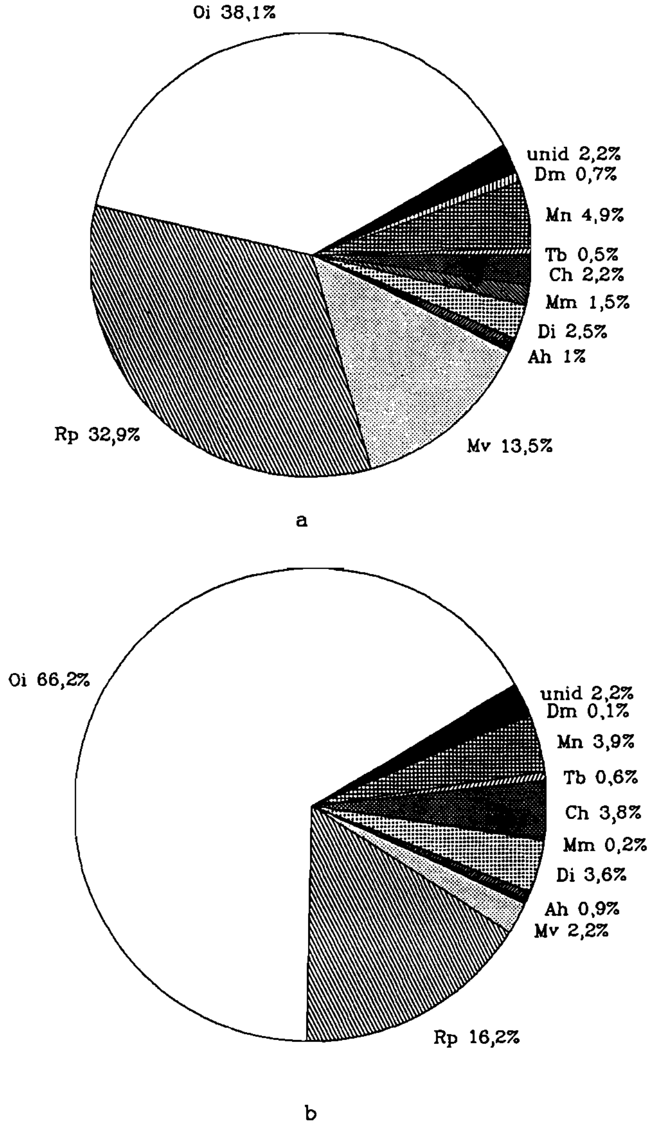

Figure 1 Small mammal component of serval diet (a) relative per cent occurrence (b) percentage biomass ingested. Ah = *Amblysomas hottentotus*; Ch = *Cryptomys hottentotus*; Di = *Dasymys incomtus*; Dm = *Dendromus melanotis*; Mn = *Mastomys natalensis*; Mm = *Mus minutoides*; Mv = *Myosorex varius*; Oi = *Otomys irroratus*; Rp = *Rhabdomys pumilio*; Tb = *Tatera brantsii*; unid = unidentified small mammal.

sis may reflect prey consumption inaccurately owing to differential digestibility of different prey types, differential passage rates of prey components, and the impossibility of determining, from faecal remains, the exact number of prey items consumed. Different methods of data presentation illustrate different aspects of the diet, while helping to avoid biases owing to inherent inaccuracies in scat analysis. Frequency of occurrence gives an indication of the importance of the prey type in providing a regular food source. Relative per cent occurrence shows the numbers of a prey type eaten relative to other prey types. Serval scats are suited to this type of analysis as most of the prey are small vertebrates, so large differences in prey digestibility are not expected. Percentage biomass ingested indicates the importance of each prey type in terms of mass contribution to the diet (i.e. one *O. irroratus* may be more important than three

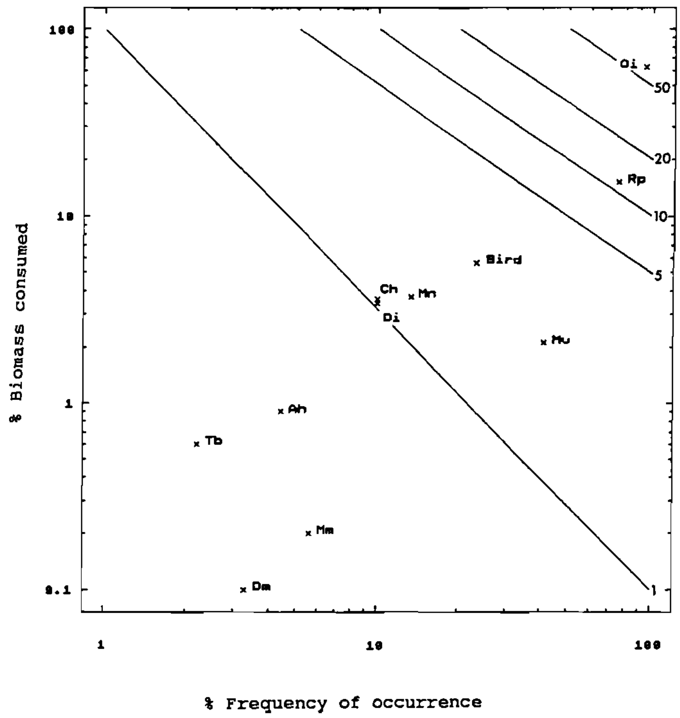

Figure 2 Relative importance of various prey types in serval diet. Isolines connect points of equal importance. *O.irroratus* is most important, then *R. pumilio*, while *D. melanotis* is least important.

Table 3 Results of cafeteria tests giving the mean score (n = 5 for each serval) for prey species eaten (0=0%, 1=1–30%, 2=31–60%, 3=61–100%)

	Serval individual			
Food	1	2	3	Total
Otomys irroratus	3,0	2,8	3,0	8,8
Rhabdomys pumilio	1,3	0,4	1,0	2,7
Myosorex varius	0,4	0	0,4	0,8
Gallus domesticus	1,3	1,0	2,2	4,5

R. pumilio). Figure 2 illustrates the importance of various prey species in serval diet, and the usefulness of different data analysis methods.

Otomys irroratus are usually associated with lush grasses and sedges near streams, marshes and vleis (Davis 1973). This habitat type corresponds to the core areas of serval home ranges (Bowland 1990). *Otomys* sp. also formed the primary component of serval diet in two earlier studies; *Otomys angoniensis* and *Mastomys natalensis* occurred in 48% of serval stomach contents analysed in Zimbabwe (Smithers 1978), while *O. angoniensis* and *Mus minutoides* were the dominant species found in scats from Ngorogoro Crater (Geertsema 1985). *O. irroratus* are comparatively large rodents, nest above the ground (Davis 1973), and are relatively slow moving, making them easy prey and giving a high energy return per unit catch effort.

Shrews (*M. varius*) occurred more frequently in the scats than expected, since most predators reject them (Ewer 1973) and they were usually rejected in cafeteria tests. However, *M. varius* are active nocturnally (Baxter, Goulden & Meester 1979) and they were abundant in the core areas of the serval home ranges, making them likely prey. *Myosorex* sp. may be less distasteful than *Crocidura* sp. which occurred in the study area, but were not found in the scats.

Flufftails were the birds most frequently occurring in serval scats, because they are associated with a similar habitat and are nocturnal (Maclean 1985). They are ground-dwelling, poor flyers, and easily caught.

This study supports results from Zimbabwe (Smithers 1978) and Ngorogoro Crater (Geertsema 1985) where servals prey almost entirely on small mammals. Observations regarding the eating of large prey are incidental and anecdotal (Pienaar 1969; York 1973; Kingdon 1977). At Kamberg there was no indication of large prey being taken. Servals are small mammal selectors, feeding mainly on *Otomys* sp., with birds contributing 5%–10% of their diet. The wide range of prey species reported indicates that they are able to use other types of prey when *Otomys* sp. are at low density. They pose little threat to small stock farmers and may be beneficial in controlling rodent pests.

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