FOOD OF *CANIS MESOMELAS* IN SOUTH AFRICA

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INTRODUCTION

The black-backed jackal is probably the most important problem animal in the sheep-farming areas of South Africa and especially in the Transvaal. To determine the extent of damage done by *Canis mesomelas* in such areas, a study was initiated to analyse the stomach contents of black-backed jackals collected in South Africa. In 1965 Grafton published a preliminary report on the food of the black-backed jackal in South Africa. Since then many additional stomachs have been collected. However, as the analysis of the stomach contents is time consuming, it is profitable to determine whether increasing the sample size beyond a certain point can add to existing knowledge. This is the primary aim of the present report.

MATERIAL

In addition to the 201 stomachs originally examined by Grafton (1965), the contents of another 224 stomachs were examined; total 425. Forty-seven of the stomachs were empty, leaving a working sample of 378. Empty stomachs were excluded from the calculations. The stomachs were collected with the aid of jackal hunting clubs, during research, and through the activities of some interested institutions and individuals. The majority of the stomachs came from the Transvaal (Table 1). In this table the geographic distribution of districts where samples of five or more stomachs were collected, is given. Samples of less than five stomachs per district came from all four provinces. In the Transvaal a total of 26 stomachs were collected in the Bethal, Bronkhorstspruit, Carolina, Ermelo, Heidelberg, Koster, Lichtenburg, Nelspruit, Ottosdal, Piet Retief, Soutpansberg, Standerton, Volksrust, Warmbaths and Waterberg districts. A total of 15 stomachs came from the Bonnievale, Engcobo, McGregor, Mount Frere, Swellendam and Vryburg districts of the Cape Province, nine came from the Bultfontein, Clocolan, Dewetsdorp, Hoopstad and Ladybrand areas of the Orange Free State, and seven from near Bergville, Estcourt and Utrecht in Natal.

No information was available on the relative abundance of food items in the field at the time of collecting. Thirty per cent of the stomachs were collected in spring, 26 per cent each in summer and winter, and 18 per cent in autumn. In 46 other stomachs the date of collection was not recorded. Sixty-three (17 per cent) of the stomachs containing food came from game reserves, and the rest from agricultural areas. Forty-five per cent of all stomachs were from males, 42 per cent from females, and the rest from animals of unknown sex. Of those stomachs

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TABLE 1

GEOGRAPHICAL DISTRIBUTION OF LOCALITIES CONTRIBUTING FIVE OR MORE STOMACHS EACH OF *Canis mesomelas* TO THE SAMPLE OF 425 STOMACHS EXAMINED IN THIS STUDY

Province	*District*	*Number of stomachs*
Transvaal ..	Belfast	17
	Bloemhof	42
	Christiana	19
	Delareyville	9
	Dullstroom	7
	Lydenburg	14
	Machadodorp	6
	Middelburg	57
	Pietersburg	19
	Potchefstroom	8
	Potgietersrust	16
	Schweizer Reneke ..	61
	Ventersdorp	13
	Wolmaransstad ..	32
Cape ..	Butterworth	10
	Qumbu	6
	Robertson	9
	Tabankulu	5
	Umtata	13
	Worcester	5

containing food, 45 per cent were from males, 41 per cent from females, and 14 per cent from unknown sex.

METHODS

Grafton (1965) regards grass, twigs, grit and stones as non-food items, while Bothma (1966) considers grass a food item of the Carnivora. Grafton removed non-food items before doing an itemised volumetric analysis of the stomach contents. The present study follows Bothma (1966). This may be one of the reasons why most of the volumetric data in the present study for each food item showed a percentage decrease when compared with the data of Grafton (1965) (Table 3).

Items with a frequency of occurrence or a percentage volume of less than 0,5 were listed as traces only. In many cases identification of food items was impossible below the class level. Some mammals were identified by microscopic analysis of hair structure. Grafton's (1965) definition of carrion was used. Carrion was identified by the presence of maggots and larvae,

TABLE 2

VOLUMETRIC ANALYSIS AND FREQUENCY OF OCCURRENCE OF THE CONTENTS OF 378 STOMACHS (EMPTY STOMACHS EXCLUDED) OF THE BLACK-BACKED JACKAL *Canis mesomelas* IN SOUTH AFRICA

Item	*Volume*			*Occurrence*		
	Actual	*PTV*	*RI*	*Actual*	*PFO*	*RI*
Animal food	54 699,9	92,1	—	368	97,4	—
Vertebrata	36 989,5	62,3	—	316	83,6	—
Mammalia	34 622,6	58,3	—	295	78,0	—
Artiodactyla ..	18 683,6	31,4	—	121	32,0	—
Wild	3 804,6	6,4	5	31	8,2	8
Domestic ..	14 879,0	25,0	2	90	23,8	4
Rodentia	6 014,5	10,1	3	109	28,8	2
Lagomorpha ..	4 500,4	7,6	4	53	14,0	6
Perissodactyla ..	67,0	Trace	—	1	Trace	—
Insectivora ..	9,4	Trace	—	2	0,5	—
Carnivora ..	486,1	0,8	—	8	2,1	—
Unidentified ..	4 861,6	8,2	—	—	—	—
Aves	2 077,3	3,5	—	88	23,3	—
Wild ..	1 024,5	1,8	9	86	22,8	5
Domestic	1 049,2	1,7	10	1	Trace	11
Reptilia	276,6	Trace	11	11	2,9	10
Amphibia	13,0	Trace	—	1	Trace	—
Invertebrata	2 786,9	4,7	—	121	32,0	—
Insecta	2 718,1	4,6	6	116	30,7	1
Myriapoda	53,6	Trace	—	9	2,4	—
Arachnida	12,5	Trace	—	17	4,5	—
Crustacea	1,2	Trace	—	2	0,5	—
Pelycopoda ..	1,5	Trace	—	1	Trace	—
Carrion	14 923,5	25,1	1	93	24,6	3
Plant food	4 388,4	7,4	—	208	55,0	—
Wild fruit, etc. ..	1 759,7	3,0	7	48	12,7	7
Grass	626,4	1,1	—	97	25,7	—
Cultivated crops ..	1 680,3	2,8	8	14	3,7	9
Unidentified	322,1	0,5	—	—	—	—
Grit, stones, sand ..	328,5	0,6	—	78	20,6	—

PTV = Percentage of total volume.
PFO = Percentage frequency of occurrence.
RI = Relative importance value.

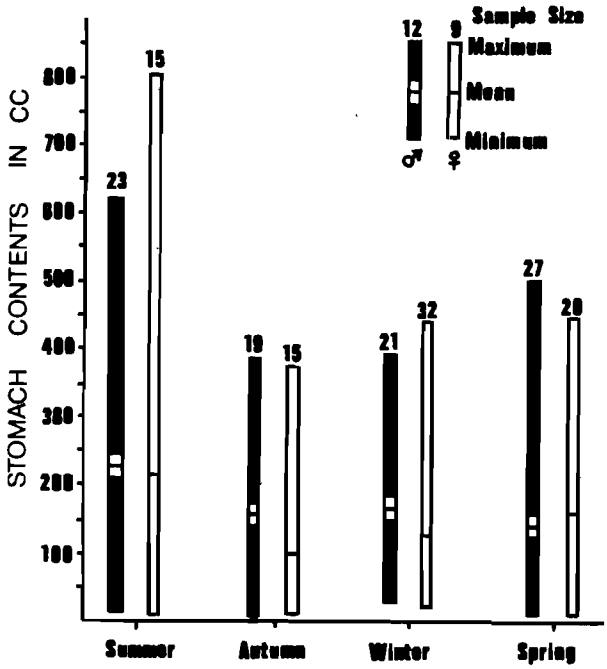

FIGURE 1
Volume of stomach contents from 180 adult *Canis mesomelas* from agricultural areas in South Africa. Empty stomachs excluded.

or by the putrid condition of the meat. Food was considered as anything eaten intentionally, and items taken by accident as non-food.

Relative importance values were determined for the major items by placing each item in a scale of decreasing frequency of occurrence, and of decreasing percentage volume. The most important item occupies position one. Where possible all relative importance values were compared with similar data in Grafton (1965).

RESULTS AND DISCUSSION

The average content of 378 stomachs was 157 cc and the maximum 1 250 cc. The average volume of the stomach content was 2,7 times that of the silver fox *Vulpes chama* (Bothma 1966). The stomachs of males contained more food than those of females in all seasons except spring (Fig. 1). On the S.A. Lombard Nature Reserve, female black-backed jackals in captivity in a 4,3 ha enclosure usually swallowed large quantities of food and regurgitated much of it later to feed their pups. As pups are reared in spring in the wild, this habit could explain the larger volume of female stomach contents at this season. On the whole, males (average 173 cc) ate a greater volume of food than females (average 153 cc). Due to the inherent vari-

ability in volume of stomach contents, from empty to completely full, it is impractical to test for statistically significant differences between average stomach contents of males and females.

Carrion, rodents, hoofed domestic stock (particularly sheep), insects and hares were the major sources of food by volume and by frequency of occurrence (Table 2). Sheep were found in some stomachs from game reserves. This suggests that some jackals may take refuge in the relative safety of game reserves whence they venture out to neighbouring farms to feed. However, the amount of sheep present in stomachs from game reserves is appreciably less than that taken by jackal in agricultural areas. Only 6,3 per cent of the stomachs from game reserves contained hoofed domestic stock, in contrast to 27,3 per cent in agricultural areas.

Among the antelope, impala *Aepyceros melampus* and springbok *Antidorcas marsupialis* were the main species eaten; also some reedbuck *Redunca arundinum*, duiker *Sylvicapra grimmia* and steenbok *Raphicerus campestris* were taken. Sheep was the main domestic artiodactyl eaten.

Rodents were another important group, more so in agricultural areas than in game reserves. A wider range of rodents was also eaten in agricultural areas. Of the rodents, rats and mice (71,9 per cent occurrence) were the most important, followed by springhare (10,4 per cent), rodent moles (4,2 per cent), porcupines (2,1 per cent), and ground squirrels (1,0 per cent). Of these, only the ground squirrel *Xerus inauris* (Sciuridae) is active in the daytime.

The identifiable rodents included members of several families and species, such as the common mole-rat *Cryptomys hottentotus* (Bathyergidae), the Cape porcupine *Hystrix africae-australis* (Hystricidae), and the springhare *Pedetes capensis* (Pedetidae). The Muridae included the red veld rat *Aethomys crysophilus*, the Namaqua rock mouse *Aethomys namaquensis*, the multimammate mouse *Praomys natalensis*, the striped mouse *Rhabdomys pumilio*, the pygmy mouse *Leggada minutoides*, the vlei rat *Otomys irroratus*, the bush Karroo rat *Otomys unisulcatus* and a gerbil of *Tatera* sp.

The hares (Leporidae) could not be identified specifically. Hares were found in 14,3 per cent of the stomachs from agricultural areas, and in 12,7 per cent of those from game reserves. Other mammals were relatively unimportant. One stomach contained fresh donkey meat, possibly carrion. Two stomachs contained Insectivora: an unidentified shrew (Soricidae) and a hedgehog *Erinaceus frontalis* (Erinaceidae). Carnivores were found in eight stomachs and consisted of an unidentified wild cat (Felidae), the striped polecat *Ictonyx striatus* (Mustelidae), some specimens of the Cape grey mongoose *Herpestes pulverulentus* (Viverridae) and the lips and nose of a domestic dog presumably bitten off in a fight.

Most bird remains consisted of feathers only. Poultry occurred in stomachs from game reserves and other areas. The Guinea-fowl *Numida meleagris* and the black korhaan *Afrotis afra* were the commonest wild prey. The reptiles consisted of two tortoises (*Psammobates* sp.) and several unidentified specimens of Scincidae and Lacertidae (lizards), and some blind burrowing snakes (Typhlopidae). One stomach contained a small monitor lizard *Varanus exanthematicus albigularis*. Other stomachs contained some snakes, including a night adder *Causus rhombeatus*. A frog *Breviceps adspersus* was found in a stomach from the Loskop Dam area of the Transvaal.

Arachnids were present in 17 cases, 15 were spiders and two scorpions. Grafton (1965) found two freshwater crabs in two different stomachs. No additional Crustacea were found.

Centipedes and millipedes occurred in stomachs collected in spring and summer, the rainy season. A single unidentified pelycopod was found in a stomach from near Butterworth in the Cape Province.

Insects were important both by volume and by frequency of occurrence. The insects present included a wide range of orders: Coleoptera (Carabidae and Scarabaeidae), Diptera, Hymenoptera (Formicidae, *Dorylus* sp.), Isoptera, Odonata and Orthoptera (Acrididae and Gryllidae). In a number of stomachs insects formed almost the entire contents. One stomach contained 1 250 termites (55,6 per cent of the contents) and another 72 crickets (94,7 per cent of the contents).

Carrion is a very important food item. In some cases fresh meat was found which could very well have been carrion, for example a freshly dead sheep, but the absence of any definite indications made it impossible to determine the true origin of the meat in question. However, most of the carrion consisted of animal remains which obviously were not fresh. Thus some stomachs contained pieces of hide, putrid flesh with maggots, and other related items. In eating so many of these items the jackal plays an important sanitary role in the field.

Plant food played a relatively minor role in the diet of *Canis mesomelas*. Of the plant items present, grass, wild fruit, berries and seeds were most important. The sedges *Scirpus* sp. and *Bulbo stylis* sp., and the grasses *Brachiaria* sp., *Eragrostis atherstonei* and *Panicum coloratum* represented the Glumacea. The Lignosae consisted of the raisinbush *Grewia* sp. (Tiliaceae), the "bloubos" *Diospyros lycioides* (Ebenaceae), a member of the Gardenia family (*Kohautia virgata* Rubiaceae), a shrub *Thesium* sp. (Santalaceae), two members of the Mimosaceae, *Acacia mearnsii* and the paper bark *Acacia woodii* and the num-num *Carissa bispinosa* (Apocynaceae). The Herbacea were represented by the "vermeerbos" *Geigeria* sp. (Compositae) and some wild figs *Ficus* sp. (Ficoidaceae).

Some of the smaller seeds may have been present in the stomachs of prey birds, however, and may therefore not have been eaten intentionally by the jackal. Cultivated crop plants occurred mostly in stomachs from agricultural areas. In addition to a stomach with 397 cc of groundnuts, two stomachs contained watermelon pips, one had sunflower seeds, one grapes and another maize.

Grafton (1965) does not regard grass as food for the black-backed jackal. However, it is my belief that grass is eaten intentionally by the jackal at times; therefore it is food. Usually present in small quantities, grass nevertheless occurred in 25,6 per cent of the stomachs. In three of these it amounted to 20,5 cc, 25,0 cc and 17,0 cc. This is 11,4, 33,7 and 40,5 per cent by volume of the respective individual contents.

In stomachs with large quantities of stones, grit and sand, fresh meat or carrion invariably also occurred. This suggests an unintentional ingestion of stones, etc., while eating the meat.

The relative incidence and volume of the major items found in the 185 stomachs examined by Grafton (1965) were compared with related data for the 378 stomachs examined here. A remarkably similar pattern was found. Although the relative importance values did not change much (Fig. 2), the volume and occurrence of several items did change with an increase in sample size (Table 3). Most of the changes in volume showed corresponding changes in occurrence and probably reflected the effect of regional changes in the distribution of the

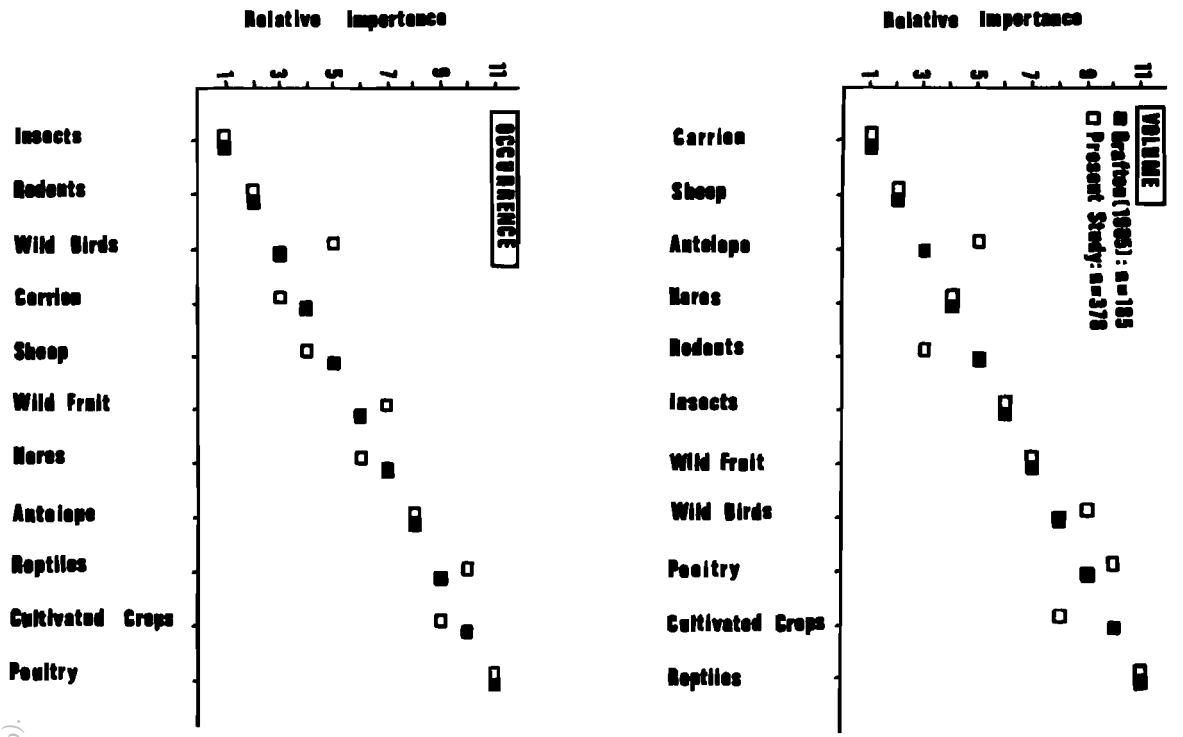

FIGURE 2
The influence of sample size on the relative importance of the major items in the stomach contents of the black-backed jackal in South Africa.

sampling sites rather than changes in the actual diet of the jackals. The majority of the items showed a decrease in volume and occurrence on a percentage basis when compared with Grafton's (1965) data. This could be due to the exclusion of certain items (e.g. grass) by Grafton from the total food volume on which the percentage volume figures are based.

The relative importance of the various items in the diet of *Canis mesomelas* showed little change with the increased sample size (Fig. 2). A slight shift in relative importance was noticeable for several food items both by volume and by frequency of occurrence. However, in only four cases (18 per cent) was this shift more than one position in the scale of importance; the shift never exceeded two positions. Eight items (36 per cent) showed a minor shift of one position on the scale, while 10 items (46 per cent), including the two most important ones, did not show any change in relative importance with an increase in sample size.

In general, the present pattern was quite close to that found by Grafton (1965). Thus it is doubtful whether the increased sample resulted in any substantial increase in the knowledge gleaned from the smaller sample. The only groups found here that were absent in Grafton's study consisted of a perissodactyl in one stomach, and a pelycopod in another. This strengthens the belief that studies of larger samples of the same kind as examined hitherto

TABLE 3

THE EFFECT OF SAMPLE SIZE ON ANALYSES BY VOLUME AND BY FREQUENCY OF OCCURRENCE OF THE STOMACH CONTENTS OF *Canis mesomelas* IN SOUTH AFRICA

Item	*Percentage Volume*			*Percentage Occurrence*		
	n=185*	*n*=378†	*Change*	*n*=185	*n*=378	*Change*
Carrion	28,7	25,1	−3,6	27,0	24,6	− 2,4
Domestic stock ..	18,5	25,0	+6,5	17,3	23,8	+ 6,5
Rodents	9,0	10,1	+1,1	32,4	28,8	− 3,6
Hares	9,4	7,6	−1,8	15,7	14,0	− 1,7
Wild artiodactyls ..	9,7	6,4	−3,3	9,7	8,2	− 1,5
Insects	8,0	4,6	−3,4	45,5	30,7	−14,8
Wild fruit, etc. ..	3,4	3,0	−0,4	16,2	12,7	− 3,5
Cultivated crops ..	1,2	2,8	+1,6	2,7	3,7	+ 1,0
Wild Birds ..	3,1	1,8	−1,3	31,4	22,8	− 8,6
Poultry	1,4	1,7	+0,3	1,1	0,4	− 0,7
Reptiles	0,8	0,4	−0,4	4,9	2,9	− 2,0

* Grafton (1965).
† Present study.

do not contribute enough new knowledge to warrant the time and effort it requires. Examination of the contents of stomachs collected at random serve at best only as indicators of items that may fall prey to the predator concerned.

It is therefore suggested that future studies pay attention to the following: (1) The availability of food in the field as related to the occurrence of these items in stomach contents. (2) A comparison of the stomach contents of jackal from a game reserve and an adjacent agricultural area. (3) Regional and seasonal studies of the diet of the jackal. (4) Comparative studies from the same region at different population levels of jackals, e.g. before and after control, and in different land-use areas.

SUMMARY

A study of the food of *Canis mesomelas* in South Africa was carried out with particular reference to the value of analysing large samples of stomachs collected at random in the field. The results indicated close similarities in percentage by volume and by occurrence of the major food items in the diet of the black-backed jackal as found by examining two samples of 185 and 378 stomachs respectively. Carrion, rodents, hoofed domestic stock (particularly sheep), insects and hares were the major food items by volume and by frequency of occurrence. Four future fields of study are suggested.

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