Importance of termites in the diet of the aardwolf *Proteles cristatus* in South Africa

R.L. Cooper and J.D. Skinner

Analysis of 81 faecal samples collected from seven different localities in South Africa revealed that termites are the most important food item in the diet of the aardwolf. *Trinervitermes* was found to be the most important genus of termite in the faeces from six of the seven localities, whilst other genera of termites, ants, other insects and millipedes mostly occurred as traces in the faeces. No vertebrate remains or traces of carrion were found.

S. Afr. J. Zool. 14: 5–8 (1979)

Analise van 81 mismonsters uit sewe verskillende omgewings in Suid-Afrika versamel het getoon dat termiete die belangrikste kositem in die dieët van die aardwolf is. *Trinervitermes* is die belangrikste termietgenus in die mismonsters uit ses van die sewe omgewings, terwyl slegs spore van ander termietgenera, miere, ander insekte en duisendpote in die mis waargeneem is. Geen werweldier-oorblyfsels of aas is gevind nie.

S.-Afr. Tydskr. Dierk. 14: 5–8 (1979)

The late R.L. Cooper and J.D. Skinner
Mammal Research Institute,
University of Pretoria, Pretoria 0002

Accepted August 1978

It has long been a moot question in South Africa whether the aardwolf *Proteles cristatus* is a specialized insectivore. Reports have been published of aardwolf eating carrion, or even killing and eating lambs *Ovis aries*. Maberley (1967) believed that aardwolf will eat carrion if it is sufficiently rotten. However, Bothma (1965) found six out of seven aardwolf stomachs to contain mainly termites *Trinervitermes* spp., the seventh containing mostly carrion and insects. On the other hand, von Ketelhodt (1966) observed that captive aardwolf refused minced meat and live small vertebrate prey, preferring a diet of *Trinervitermes* spp. Moreover, Kruuk & Sands (1972) found that the Serengeti aardwolf's diet consists almost entirely of *Trinervitermes* spp. The object of the present study was to examine the importance of different species of termites in the aardwolf's diet in parts of South Africa.

Methods

As aardwolf use latrines it is not difficult to collect faeces once these have been located. Faeces were collected whenever possible at different times of the year from Hester Malan Wild Flower Reserve (29°34′S, 17°57′E) in the north-western Cape, Willem Pretorius Game Reserve (28°17′S, 27°10′E) in the Orange Free State, Nylsvley (24°22′S, 28°36′E) near Moloto in the central Transvaal, Rhenosterpoort Private Game Reserve (25°44′S, 28°57′E) near Bronkhorstspruit in the central Transvaal, the farm Athole (26°32′S, 30°34′E) near Amsterdam in the eastern Transvaal, and Vaalboschfontein Estates (27°16′S, 25°56′E) near Wolmaranstad in the western Transvaal.

Samples for analysis were randomly selected by a process of multistage sample selection, whereby an increasingly smaller subsample or aliquot was selected at each stage, until a 20 g dry mass sample was obtained. This was left to dissolve in water, and when soft and separable, gently crushed with a pestle and mortar until all the organic material was liberated and began to float. The liquid was poured through a funnel containing filter paper, allowed to drain, and then viewed under a dissection microscope. Termites could be clearly identified from undigested worker and soldier head capsules, species identification being dependant on the presence of soldiers. The material in the

Table 1 Contents of aardwolf faeces in summer and winter (66 samples from four localities)

Date	Nylsvley (n = 6)[a] Summer (3)[a] 25 Sep 76			Nylsvley (n = 6)[a] Winter (3) May-Sep 76			Leeufontein (n = 21) Summer (3) Dec 76-Apr 77			Leeufontein (n = 21) Winter (18) May-Aug 76			Hester Malan (n = 27) Summer (6) 6 Oct 76			Hester Malan (n = 27) Winter (21) Apr-Aug 76			Vaalboschfontein (n = 12) Summer (3) Jan-Apr 77			Vaalboschfontein (n = 12) Winter (9) May-Jun 77		
Category	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]
Trinervitermes sp.	2	100	2	94	100	93,6	95	100	95,3	94	100	94,5	86	100	86,0	94	100	93,9	93	100	93,0	70	100	69,8
Hodotermes sp.	95	100	94,6	3	100	3	—	—	—	0,5	22	0,1	—	—	—	—	—	—	—	—	—	0,3	25	+
Microhodotermes sp.	—	—	—	—	—	—	—	—	—	—	—	—	10	50	5,2	0,4	23	0,1	—	—	—	—	—	—
Odontotermes sp.	+[e]	100	+	0,3	67	0,2	—	—	—	—	—	—	—	—	—	—	—	—	+	33	+	19	75	14
Macrotermes sp.	—	—	—	+	67	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lepidotermes sp.	—	—	—	—	—	—	—	—	—	+	4	+	—	—	—	—	—	—	—	—	—	—	—	—
Formicidae	+	100	+	+	33	+	+	33	+	0,1	56	0,6	1	100	1,2	0,1	43	+	+	67	+	3	75	2
Coleoptera	+	33	+	—	—	—	+	33	+	—	—	—	0,2	33	+	0,8	38	0,3	+	67	+	+	50	+
Diptera pupae[f]	—	—	—	—	—	—	—	—	—	+	22	+	—	—	—	—	—	—	—	—	—	—	—	—
Other Insecta	—	—	—	+	67	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Myriapoda	—	—	—	—	—	—	—	—	—	+	6	+	—	—	—	—	—	—	+	67	+	—	—	—
% Plant content	3			3			5			6			2			4			7			8		
% Sand in dry mass	2			0,4			15			12			40			34			15			22		
Worker/Soldier ratio	50/50			70/30			50/50			59/41			50/50			40/60			50/50			47/53		

[a] Number of samples
[b] Average % proportion in faeces
[c] Average % occurrence
[d] Importance value (see text)
[e] Present (+) but <1,0%
[f] Result of post-deposition fly breeding

beaker which sank (and was therefore not included in this analysis) was viewed separately under a dissection microscope so that heavy objects would not be overlooked.

Eighty-one such samples were selected from some 20 kg of faeces, examined, and all the food categories on each paper were counted in ten fields of the microscope. Percentage proportion (by occurrence) was calculated as an average for ten fields. Species occurring in less than one per cent proportions were allocated a plus value (Table 1). Percentage occurrence was defined as the number of times a food category occurred within a given number of analyses, as a percentage of the total given number of analyses. The percentage proportion and percentage occurrence of each food category was averaged for each locality, as well as for each season where possible, and importance values (IV) were calculated by the formula $IV = (\%P \times \%O)/100$, where %P is the average percentage proportion and %O is the average % occurrence.

Results

When the data are grouped into different seasons an idea of seasonal fluctuations in the importance of the different food categories can be obtained (see Table 1). *Trinervitermes* spp. maintains a high importance value (IV) in all except the summer samples from Nylsvley, where it was only 2. This is due to the high average percentage proportion (%P) of *Hodotermes mossambicus*, namely 94,6%. The latter genus does not occur in large amounts in any other sample, but *Microhodotermes viator*, a closely related genus, is relatively important in the summer samples from Hester Malan (IV = 5,2). Ants (Formicidae) occur in almost all the samples in small numbers, whilst *Odontotermes* sp. was only present in faeces from Nylsvley and Vaalboschfontein. This genus is relatively important in faeces from the latter locality, particularly in winter where the IV reaches 14,3. Diptera pupae are represented only in the Leeufontein winter samples, and were the result of post-deposition fly breeding.

The faecal content data for seven different localities is presented in Table 2. Athole, Willem Pretorius and Rhenosterpoort data should not be directly compared with the other localities since they are only representative of the summer period. A relatively high average percentage occurrence (%O) value for *Odontotermes* sp. in the Nylsvley (83,3%) and Vaalboschfontein (61,1%) samples is noteworthy in view of the total absence of this genus in all other samples. On a visit to Vaalboschfontein high densities of *Odontotermes* sp. ventilation turrets were noticed near the area where some of the faeces were collected. Formicidae are important in the Vaalboschfontein and Rhenosterpoort samples (IV = 0,2 and 13,7 respectively). *Macrotermes* sp. occurred as traces in the Nylsvley samples, the only samples in which they were found. Coleoptera occur in faeces from all the localities, and are most important in the Hester Malan samples (IV = 0,21). Other Insecta (mostly Hemiptera, Orthoptera and Coleoptera larvae) occur in small percentages in all but the Leeufontein samples.

The distribution records of aardwolf in South Africa are somewhat sparse (Fig. 1), but the distribution of the genus *Trinervitermes* has been well documentated (Fig. 2).

All the areas where middens were located were in open areas, usually short grassveld in close proximity to where *Trinervitermes* were most active. This apparently has an important bearing on midden distribution. For example, the farm near Moloto was about 670 ha yet all the middens, some of which were not used frequently, were situated in an

Table 2 Average contents of aardwolf faeces (81 samples from seven localities)

Date	Nylsvley (n = 6) May–Sept 76			Leeufontein (n = 21) May–Aug 76 Dec 76–Jul 77			Hester Malan (n = 27) Apr–Sep 76			Vaalboschfontein (n = 12) Jan–May 75			Athole (n = 6) Jan–June 77			WPGR[a] (n = 6) Oct 76–Jan 77			Rhenosterpoort (n = 3) Feb–Jun 77		
Category	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]	%P[b]	%O[c]	IV[d]
Trinervitermes sp.	48	100	47,8	95	100	94,7	91	100	91,2	77	100	77,5	91	100	90,6	93	100	92,6	78	100	78,0
Hodotermes sp.	49	100	48,8	0,4	17	0,06	—	—	—	0,2	17	+	—	—	—	—	—	—	—	—	—
Microhodotermes sp.	—	—	—	—	—	—	4	32	1,2	—	—	—	—	—	—	—	—	—	—	—	—
Odontotermes sp.	0,3	83	0,3	—	—	—	—	—	—	13	61	7,8	—	—	—	—	—	—	—	—	—
Macrotermes sp.	+[e]	33	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lepidotermes sp.	—	—	—	+	3	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Formicidae	+	67	+	+	50	+	0,4	51	0,2	2	72	1,4	+	67	+	+	67	+	14	100	13,7
Coleoptera	+	17	+	+	8	+	0,6	37	0,2	+	55	+	+	50	+	+	50	+	+	33	+
Diptera pupae[f]	—	—	—	+	17	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other Insecta	+	33	+	—	—	—	+	5	+	+	5	+	+	17	+	+	33	+	+	67	+
Myriapoda	—	—	—	+	4	+	—	—	—	+	22	+	—	—	—	—	—	—	—	—	—
% Plant content	3			5			4			7			9			7			8		
% Sand in dry mass	1			12			36			19			9			5			20		
Worker/Soldier ratio	60/40			59/41			43/57			48/52			42/48			56/44			49/51		

[a] Willem Pretorius Game Reserve
[b] Average % proportion in faeces
[c] Average % occurrence
[d] Importance value (see text)
[e] Present (+) but <1,0%
[f] Result of post-deposition fly breeding

area of 12 ha with a density of 1/1,2 ha. Similarly at Hester Malan Wild Flower Reserve the density of middens for the whole Reserve was 1/700 ha but all the middens were located in an area of only about 100 ha giving an actual density of 1/14 ha.

Discussion

It must be stressed that the number of samples (81) relates to faecal samples and not to individual aardwolf. The number of aardwolf from which faeces were obtained is possibly about 20 individuals, though it may be more. The possibility of biasing of results owing to unequal sample size can be practically disregarded on account of two factors. In the first place, multistage faecal sample selection allows for random representation of faecal constituents in the analysis, and secondly faeces were collected completely at random. The seven localities range from the extreme arid north-western Cape, through the Transvaal grassveld and savannas, to the humid grassveld of the eastern Transvaal highlands.

The most important genus of termite was *Trinervitermes* which occurred in all of the 81 samples, ranging from 1% to

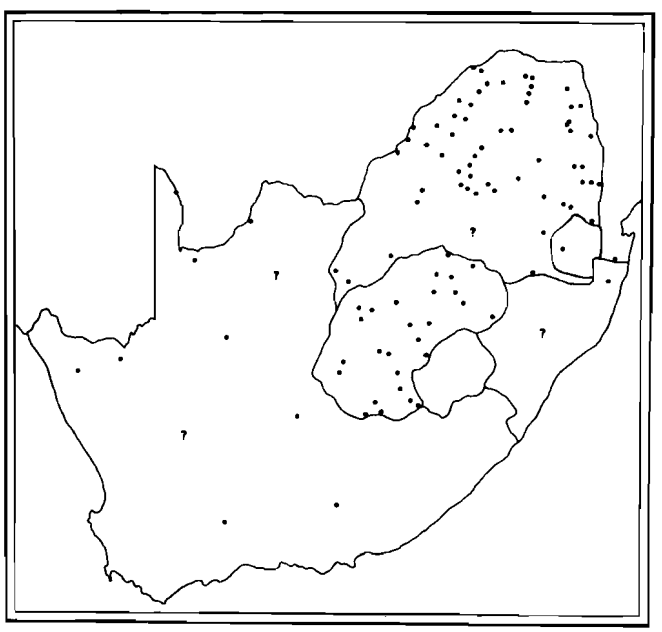

Fig. 1 Known distribution of aardwolf in South Africa.

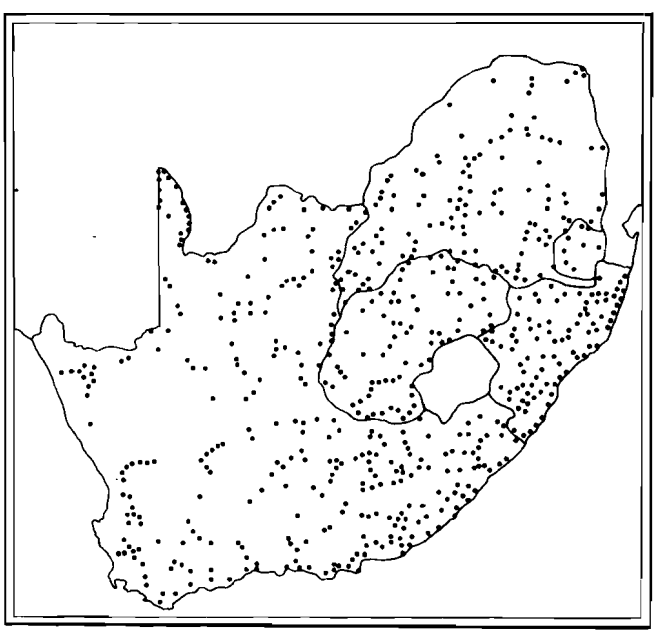

Fig. 2 Distribution of *Trinervitermes* spp. in South Africa (after Coaton 1963).

99%, but on average mostly in excess of 70% of the faecal organic matter. The main reason for the dominance of *Trinervitermes* spp. in the diet of aardwolf has already been discussed by Kruuk & Sands (1972), namely that it is the regular nocturnal emergence of large foraging parties which makes them easily obtainable by lapping up from the ground surface. Two further factors could be the wide distribution of the genus *Trinervitermes* in South Africa (see Fig. 2), as well as the high density of mounds in areas where it occurs.

The presence of Formicidae (ants) in the faeces probably results from accidental ingestion by the aardwolf whilst feeding on termites, although deliberate ingestion cannot be discounted. The Rhenosterpoort sample is an example of this, and this is probably connected with decreased availability of *Trinervitermes* spp.

Hodotermes sp. and *Microhodotermes* sp. are most prominent in the faeces during the summer season. The reasons are that the aardwolf is mainly a nocturnal forager, and hodotermids emerge to forage by day in winter, and during the relatively warm and humid nights in summer (Coaton & Sheasby 1974 and 1975).

Other termites in the faecal samples were *Odontotermes* sp., *Macrotermes* sp. and *Lepidotermes* sp., none of which are regular above-ground foragers, and hence are not as well represented in the faeces as the three genera of harvesting termites. The presence of a high percentage proportion of *Odontotermes* sp. in the Vaalboschfontein samples can be ascribed to the activity of these termites within the above-ground ventilation turrets. Workers, guarded by a large number of soldiers, are often found in the open fan-like structures at the apex of these turrets during repair operations, thus being easily available for lapping up. It is to be expected that a meal of *Odontotermes* sp. obtained in this fashion would contain a large proportion of soldiers. The Vaalboschfontein samples contained on average 80% workers and 20% soldiers, which is an unusually high proportion of soldiers for a genus belonging to the family Macrotermitidae (W.G.H. Coaton *pers. comm.*)

It can be seen from the analyses that the dominant position attained by *Trinervitermes* spp. in the faeces does not fluctuate significantly on a seasonal basis, with the exception of the samples from Nylsvley, contrary to the decline in the proportion of *Trinervitermes* spp. in the faeces during the rains recorded by Kruuk & Sands (1972) in the Serengeti. The latter authors found no trace of *Trinervitermes trinervoides* in the faeces of the aardwolf, although it did occur in the study area. In this study however, the latter species was the most common nasute termite in the faecal samples. These differences are likely to be the result of environmental differences between these two particular areas.

No vertebrate remains could be distinguished in the faeces in the present study, in spite of many reports of aardwolf eating carrion, small mammals, birds' eggs and reptiles. If carrion had been consumed, hair belonging the the carcasses would surely have been found in the faeces but the only hair found in the faeces belonged to aardwolf. The presence of Diptera pupae in the faeces is not indicative of carrion consumption either, since they were noted to be living when the faeces were collected and were the result of post-deposition fly breeding. One can only assume that the reports of aardwolf associating with carcasses are probably the result of the presence of maggots and carrion insects, which the aardwolf will eat when other food is scarce.

The presence of large quantities of sand, grit and plant matter in the faeces supports the observations made by Kruuk & Sands (1972) that aardwolf obtain termites by lapping them up from the ground surface, and do not open mounds. Moreover, the presence of *Lepidotermes* sp., a ground-dwelling humus feeder, is additional evidence in this concern.

A number of authors have proposed that the distribution of the aardwolf is likely to be determined by the distribution of *Trinervitermes* spp. (von Ketelhodt 1966. Kruuk & Sands 1972). This seems logical since there can be little doubt that this genus forms the principal food of the aardwolf in most areas where studies have been carried out. Considering the two distribution maps however, there are no records of aardwolf that cannot be related to nearby records of *Trinervitermes* spp., but further information is required before any definite conclusion on this matter can be reached.

Acknowledgements

We thank Dr W.G.H. Coaton and Dr J.E. Ruelle for identification of termite remains and helpful advice, and Messrs. R. Dieckmann, J.L. Bester, F.M. Lindberg and S. Lindberg for collecting aardwolf faeces.

References

BOTHMA, J. DU P. 1965. Random observations on the food habits of certain Carnivora (Mammalia) in Southern Africa. *Fauna Flora* Pretoria, 16: 16-22.

COATON, W.G.H. 1963. Survey of the termites (Isoptera) of the Kalahari thornveld and shrub bushveld of the R.S.A. *Koedoe* 6: 38-68.

COATON, W.G.H. & SHEASBY, J.L. 1974. National survey of the Isoptera of Southern Africa. 6. The Genus *Microhodotermes* Sjöstedt (Hodotermitidae). *Cimbebasia* Ser. A. 3: 47-59.

COATON, W.G.H. & SHEASBY, J.L. 1975. National survey of the Isoptera of Southern Africa. 10. The Genus *Hodotermes* Hagen (Hodotermitidae). *Cimbebasia* Ser. A. 3: 106-137.

KRUUK, H. & SANDS, W.A. 1972. The aardwolf (*Proteles cristatus* Sparrman) 1783 as a predator of termites. *E. Afr. Wildl. J.* 10: 211-227.

MABERLEY, C.T.A. 1967. The game animals of Southern Africa. Nelson, Johannesburg.

VON KETELHODT, H.F. 1966. Der Erdwolf (*Proteles cristatus*). *Z. Säugtierk.* 34: 300-310.