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ARTHROPODS AND HELMINTHS IN SPRINGBOK *(ANTIDORCAS MARSUPIALIS)* AT BENFONTEIN, KIMBERLEY

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ABSTRACT

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From July 1979–December 1980, 48 springbok were culled for a parasite survey at Benfontein. Lice were the dominant parasites and reached a peak in September. *Damalinia antidorcus, Linognathus antidorcitis, Linognathus armatus* and *Linognathus euchore* were the most prevalent species, nymphs in most cases outnumbering adults. During the winter months, 2nd and 3rd instar *Rhinoestrus antidorcitis* and *R. vanzyli* (nasal bot-flies) were present. The number of helminths reached a peak in January and then fell, secondary peaks being recorded through autumn, winter and spring, but a rise in numbers occurred the following December. *Paracooperia serrata, Trichostrongylus* spp., *Strongyloides* spp., *Cooperioides antidorca* and *Longistrongylus sabie* adults were dominant. Fourth stage larvae (L_4) of *Ostertagia* outnumbered adult *Ostertagia hamata*, but L_4 of *Trichostrongylus* spp. were less plentiful than adults of this genus. Good spring and summer rains (414,6 mm from October–March) were probably responsible for mean total burdens exceeding 10 000 in January and April.

INTRODUCTION

A recent parasite survey of springbok in Lichtenburg, Krugersdorp and Swellendam was carried out by Horak, Meltzer & De Vos (1982a). They recovered the following genera:

Arthropods: *Boophilus, Damalinia, Ixodes, Linognathus* and *Rhipicephalus*.

Nematodes: *Agriostomum, Cooperia, Cooperioides, Dictyocaulus, Gongylonema, Haemonchus, Impalaia, Longistrongylus, Nematodirus, Oesophagostomum, Ostertagia, Paracooperia, Trichostrongylus* and *Trichuris*.

Cestodes: *Avitellina*.

Dr H. Ebedes of the South African National Zoological Gardens requested us to examine the springbok at Benfontein, Kimberley, and during July 1979, 6 springbok were shot and all the parasites recovered were identified and counted. Consultations with the management of the farm resulted in a seasonal incidence survey for the period November 1979 to December 1980. The present paper describes the results of these different surveys.

MATERIALS AND METHODS

Grazing and climate

Benfontein (a farm 9 300 ha in extent) is less than 10 km from the city of Kimberley (28°52′S, 24°48′E altitude 1 200 m.) The grazing is mainly pan surrounded and dominated by *Pentzia* spp., *Salsola, Nestlaria* with other Karoo shrubs, *Sporobolus coromendelianus, Eragrostis lehmanniana,* and a portion of Kalahari sandveld where *Acacia erioloba* and *Stipagrostis ciliata* dominate. Water is supplied by natural springs, bore-holes powered with windmills and pans scattered throughout the farm. The annual rainfall is 426 mm, most of it falling in spring and late summer from November–March.

Animals

Six springbok of various ages were shot on 21 July 1979 and thereafter 3–5 springbok were shot every 5–7 weeks from 28 November 1979 to December 1980.

Necropsy

The animals were transported to a work table where the teeth were examined and the animals aged, according to the system of Rautenbach (1971), the sex noted, and each animal was given a number. All the specimens mentioned below were placed either in small (31 × 61 cm) or large (61 × 100 cm) plastic bags which had been labelled, and the mouth of the bag tied off with twine (4 mm diameter) for sealing.

A solution of an acaricide which paralyses ticks, prepared by adding 20 mℓ of Amitraz* per 10 ℓ of water, was poured into 4 separate plastic bags prior to receiving specimens of the hide, tail and limbs. The limbs comprised those parts from the knees or hocks to the hooves. The head was placed in a labelled plastic bag, but no Amitraz solution was added.

The carcass was split along the ventral midline from the chest cavity to the pubis and the pluck and intestinal tract were removed. Any lesions present were noted. The trachea, heart, lungs and liver were separated from the gut and placed in a bag.

A double ligature was placed around the omaso-reticular junction and the reticulum and rumen were removed and opened with a butcher's knife. The ingesta were tipped out, examined for *Paramphistomum* spp. and then discarded. The mesentery was stripped from the entire gastro-intestinal tract and the omasum, abomasum and intestinal tract placed in a labelled plastic bag. Once all the specimens were tied and sealed in separate plastic bags, they were placed in a special double-sided plastic container whose inner dimensions were 58 × 43 × 42 cm and outer dimensions 69 × 54 × 47 cm, and having a lid 70 × 56 × 10 cm. In between the plastic bags containing the specimens, pieces of frozen CO_2 ("dry ice"), ranging in size from small chips to blocks 5–6 cm^3, were placed to act as a cooling agent. The lid was placed in position, roped securely and the container air-freighted to Onderstepoort. In the laboratory the pluck and gastro-intestinal tract were placed in a deep-freeze and stored at −4 °C until they were processed.

Arthropods

On the day after the animals were shot the hide was removed from the dipping fluid and thoroughly scraped with a wire brush, the bristles of which had been cut off to a length of 15–20 mm. The hair and any parasites was transferred to a labelled, wide-mouthed 1 ℓ jar to which formalin was added as a preservative. The skin of the head, ears, feet and tail were also scraped and the hair and parasites preserved in formalin in labelled jars.

One of the jaws of the head was placed in a vice and the head bisected along the midline. The turbinate bones and sinuses were opened with pruning shears and examined for nasal bot-flies. Any specimens found were placed in labelled jars and preserved in 60 % alcohol.

Arthropods were identified from the descriptions of the authors listed in Table 1.

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TABLE 1 List of authors whose descriptions were used in the identification of arthropods recovered from springbok at Benfontein

Species	Author
Lice	
Damalinia antidorcus	Ledger, 1980
Linognathus antidorcitis	Fiedler & Stampa, 1956
Linognathus armatus	Fiedler & Stampa, 1956
Linognathus bedfordi	Ferris, 1932
Linognathus digitalis	Kleynhans, 1968
Linognathus euchore	Waterson, 1914
Louse flies	
Hippobosca rufipes	Zumpt, 1966
Lipoptena sepiacea	Maa, 1965
Nasal bot-flies	
Rhinoestrus antidorcitis	Zumpt, 1965
Rhinoestrus vanzyli	Zumpt, 1965
Ticks	
Amblyomma hebraeum	Howell, Walker & Nevill, 1978
Rhipicephalus evertsi evertsi	Howell *et al.*, 1978

Helminths

Liver

The liver was palpated and cut into slices 5–10 mm wide. The cut surface was examined and the slices were pressed to expel any parasites.

Lungs

The larynx, trachea and bronchi were opened with sharp pointed scissors, examined macroscopically for worms and washed into buckets with a strong jet of water. The water in the bucket was sieved on a fine meshed brass sieve (38 μm apertures), the residues were transferred to labelled jars and preserved in formalin. The lungs were also palpated for the presence of any parasitic cysts.

Gastro-intestinal tract

Ligatures were tied at the pyloric and ileocaecal valves and the gut separated into 3 separate specimens:

(a) the omasum and abomasum,
(b) the small intestine, and
(c) the caecum and colon.

The ingesta of the abomasum and small intestine were poured on to a fine meshed brass sieve (apertures 38 μm) and sprayed with a strong jet of water.

Washed residues were transferred to labelled wide-mouthed 1 ℓ glass jars to which formalin was added as a preservative. Colonic ingesta were washed on coarser mesh sieves (150 μm apertures), but otherwise processed as described above. The ingesta from Springbok No. 1–6 were washed on to coarse sieves at Benfontein, formalinized and then transported to the laboratory.

The abomasum was scraped and the mucosa and muscularis layers were removed and digested with a pepsin HCl mixture, as described by Reinecke (1973). The small intestinal, caecal and colonic walls were also scraped and the mucosa and muscularis layers digested at 40 °C, as described by Reinecke (1973). The specimens were fixed in formalin and washed with hot water on sieves (38 μm apertures). The washed, digested residue was poured into labelled jars and preserved with formalin.

The preparation of specimens for microscopic examination followed methods already described (Reinecke 1973).

All the digested gut wall and 1/10 aliquots of the ingesta of the abomasum, small intestine, caecum and colon were microscopically examined. The remaining 9/10 of the caecal and colonic ingesta were also macroscopically examined for worms.

Worms were identified from the descriptions of the authors listed in Table 2.

TABLE 2 List of authors used to assist in the identification of helminths recovered from springbok at Benfontein

Species	Authors
Agriostomum equidentatum	Mönnig, 1933
Cooperioides antidorca	Mönnig, 1931
Dictyocaulus magnus	Mönnig, 1932
**Ostertagia* (like L_4)	Douvres, 1956
Trichostrongylus spp. (L_4)	Douvres, 1957
Longistrongylus sabie	Gibbons, 1977
Oesophagostomum africanum	Mönnig, 1933
Ostertagia hamata	Mönnig, 1932
Paracooperia serrata	Mönnig, 1931; Gibbons, 1978
Strongyloides spp.	Mönnig, 1931
Trichostrongylus colubriformis	Mönnig, 1934
Trichostrongylus falculatus	Mönnig, 1931
Trichostrongylus minor	Mönnig, 1932

* The L_4 resembled those of *Ostertagia ostertagi* described by Douvres 1956

Weather

Records were kept of the rainfall and maximum and minimum temperatures.

RESULTS

Lice

Lice were consistently present in higher numbers than any other external parasites (compare Table 3 and 4).

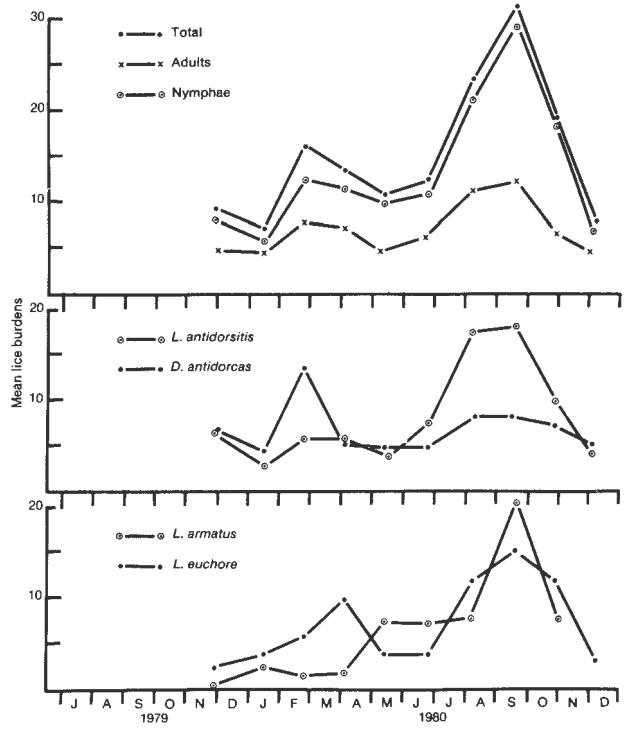

FIG. 1 Lice: variations in total, adult and nymphal lice burdens, and in the total burdens of species *D. antidorcus*, *Linognathus antidorcitis*, *Linognathus armatus* and *Linognathus euchore* in springbok at Benfontein

TABLE 3 Lice recovered at autopsy from springbok at Benfontein

Springbok No. Age Group Sex M=male F=female	*Damalinia antidorcus*		*Linognathus antidorcitis*		*Linognathus armatus*		*Linognathus bedfordi*		*Linognathus digitalis*		*Linognathus euchore*		Total
	N*	A**	N	A	N	A	N	A	N	A	N	A	
21 July 1979													
1:3:M[1]		212		393		50		10		0		186	851
2:3:F[1]		12		71		67		8		0		11	169
3:6:M[1]		6		76		4		0		184		0	270
4:7:F[1]		31		12		0		4		0		14	61
5:6:M[1]		43		321		33		0		0		40	437
6:8:F[1]		100		132		87		4		0		78	401
Mean[1]		67,33		167,5		40,17		4,33		30,67		54,83	364,83
28 November													
7:7:M	6:	6	65:	11	4:	0	0:	0	0:	0	0:	0	92
8:5:F	19:	10	0:	0	0:	0	0:	0	0:	0	1:	1	31
9:5:M	85:	47	24:	5	0:	0	1:	0	0:	0	0:	0	162
10:6:F	33:	9	6:	1	0:	0	0:	0	0:	0	0:	0	49
11:6:F	3:	1	70:	10	0:	0	0:	0	0:	0	22:	3	109
Mean	29,2:	14,6	33,0:	5,4	0,8:	0	0,2:	0	0:	0	4,6:	0,8	88,6
16 January 1980													
12:5:M	12:	2	10:	1	0:	0	0:	0	0:	0	0:	0	25
13:6:F	39:	19	7:	3	0:	0	0:	0	13:	4	38:	14	137
14:6:M	0:	1	3:	1	8:	13	0:	0	2:	16	0:	0	44
15:8:F	0:	0	1:	0	0:	0	0:	0	0:	0	0:	0	1
Mean	12,75:	5,5	5,25:	1,25	2,0:	3,25	0:	0	3,75:	5,0	9,5:	3,5	51,75
20 February													
16:5:M	21:	0	10:	5	0:	0	0:	1	0:	0	0:	0	37
17:7:F	3:	1	1:	1	0:	0	0:	0	0:	0	2:	1	9
18:1:F	3:	1	61:	10	0:	0	31:	7	0:	0	109:	16	238
19:7:F	439:	265	12:	3	9:	1	9:	2	0:	0	4:	3	747
Mean	116,5:	66,75	21,0:	4,75	2,25:	0,25	10,0:	2,50	0:	0	28,75:	5,0	257,75
2 April													
20:7:F	0:	1	5:	2	0:	0	0:	0	0:	0	0:	0	8
21:6:M	6:	5	3:	1	0:	0	0:	0	0:	0	149:	64	228
22:6:M	57:	32	76:	24	0:	1	0:	0	0:	0	199:	49	438
23:7:F	4:	5	0:	0	8:	8	0:	0	104:	47	3:	7	186
24:5:M	5:	8	25:	13	1:	1	0:	0	0:	0	1:	1	55
Mean	14,4:	10,2	21,8:	8,0	1,8:	2,0	0:	0	20,8:	9,4	70,4:	24,2	183,0

TABLE 3 *(continued)*

Springbok No. Age Group Sex M=male F=female	*Damalinia antidorcus*		*Linognathus antidorcitis*		*Linognathus armatus*		*Linognathus bedfordi*		*Linognathus digitalis*		*Linognathus euchore*		Total
	N*	A**	N	A	N	A	N	A	N	A	N	A	
13 May													
25:6:F	29:	11	0:	0	0:	0	0:	0	0:	0	3:	0	43
26:6:M	22:	8	26:	2	0:	0	0:	0	0:	0	0:	0	58
27:7:F	10:	3	1:	1	0:	0	0:	0	0:	0	5:	2	22
28:2:F	4:	4	16:	7	212:	24	15:	15	0:	0	35:	11	343
Mean	16,25:	6,5	10,75:	2,50	53,0:	6,0	3,75:	3,75	0:	0	10,75:	3,25	116,5
25 June													
29:2:F	16:	14	17:	23	115:	11	11:	12	0:	0	16:	21	256
30:6:M	12:	7	8:	3	1:	3	0:	0	0:	2	0:	0	36
31:3:F	8:	0	143:	16	0:	59	19:	13	0:	0	18:	2	278
32:7:F	4:	11	8:	1	0:	0	0:	0	0:	0	0:	0	24
Mean	10,0:	8,0	44,0:	10,75	29,0:	18,25	7,5:	6,25	0:	0,5	8,5:	5,75	148,5
6 August													
33:3:F	43:	22	90:	46	206:	7	0:	0	0:	7	106:	60	587
34:5:M	48:	31	65:	18	3:	0	3:	1	0:	0	40:	13	222
35:5:M	51:	21	711:	127	23:	3	0:	0	0:	0	230:	48	1214
36:5:F	26:	17	83:	46	9:	1	0:	0	0:	0	30:	16	228
Mean	42,0:	22,75	237,25:	59,25	60,25:	2,75	0,75:	0,25	0:	1,75	101,5:	34,25	562,75
7 September													
37:3:M	102:	43	145:	86	471:	35	0:	0	0:	0	130:	66	1078
38:6:M	26:	19	48:	24	49:	3	2:	0	0:	0	38:	10	219
39:2:F	6:	4	611:	90	645:	3	9:	9	0:	1	252:	42	1672
Mean	44,67:	22,0	268,0:	66,67	388,33:	13,67	3,67:	3,0	0:	0,33	140,0:	39,33	989,67
29 October													
40:3:M	15:	5	33:	7	202:	18	0:	0	0:	0	9:	2	291
41:6:M	1:	2	163:	27	12:	1	0:	0	50:	12	23:	4	295
42:6:F	7:	2	20:	1	1:	0	0:	0	5:	1	0:	0	37
43:1:F	107:	57	117:	4	0:	0	28:	3	0:	0	495:	19	830
Mean	32,5:	16,5	83,25:	9,75	53,75:	4,75	7,0:	0,75	13,75:	3,25	131,75:	6,25	363,25
3 December													
44:3:M	12:	6	0:	0	0:	0	0:	0	0:	0	18:	4	40
45:6:M	1:	1	0:	0	8:	1	0:	0	0:	0	12:	1	24
46:5:F	35:	34	13:	5	11:	0	1:	0	0:	0	0:	0	99
47:6:F	10:	5	12:	3	4:	0	0:	0	0:	0	0:	0	34
48:7:F	21:	8	42:	7	16:	0	0:	0	0:	0	0:	0	94
Mean	15,8:	10,8	13,4:	3,0	7,8:	0,2	0,2:	0	0:	0	6,0:	1,0	58,2

* Nymphs ** Adults (1) Nymphs and adults not differentiated in Springbok No. 1–6

TABLE 4 Louse flies, nasal bots and ticks recovered at autopsy from springbok at Benfontein. Age groups and sex of springbok see Table 3

Springbok No.	*Hippobosca rufipes*	*Lipoptena sepiacea*	*Rhinoestrus antidorcitis*		*Rhinoestrus vanzyli*		*Amblyomma hebraeum*		*Rhipicephalus evertsi evertsi*		*Boophilus decoloratus*	
			L_2	L_3	L_2	L_3	larvae	adult	larvae	nymphs	larvae	adult
21 July 1979												
1	0	4	0	4	1	5	0	0	0	0	0	0
2	0	1	0	0	0	0	0	0	0	0	0	1
3	0	0	0	1	0	0	0	0	0	0	0	1
4	0	0	0	3	0	2	0	0	0	0	0	0
5	2	3	0	10	0	0	0	0	0	0	2	0
6	2	0	0	3	0	3	0	0	0	0	0	0
28 November												
7	0	1	0	0	0	0	0	0	3	2	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	1	0	0	0	0	0	0	9	2	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	1	0	0	0	0	0	0	1	0	0	0
16 January 1980												
12	0	2	0	2	2	0	0	0	61	1	0	0
13	0	0	0	1	3	0	0	0	5	5	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	1	0	0	0	0	0	0	0	0	0	0
20 February												
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	1	0	0	0	0	0	0	0	0	0	0
19	0	1	0	0	0	0	0	0	1	0	0	0
2 April												
20	0	0	0	0	0	0	0	0	1	0	0	0
21	0	0	0	0	0	0	0	0	78	0	0	0
22	0	1	0	0	0	0	0	0	2	1	0	0
23	0	0	0	0	0	0	0	0	1	0	0	0
24	0	2	0	0	0	0	1	0	1	0	0	0
13 May												
25	0	0	0	0	0	0	0	0	18	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	6	0	0	0	0	0	0	1	0	0	0
25 June												
29	0	1	0	0	0	0	0	0	0	1	0	0
30	0	0	0	2	5	0	0	0	1	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	25	11	0	0	0	1	3	0	0
6 August												
33	0	1	0	16	2	0	0	0	0	0	0	0
34	2	0	0	0	2	0	0	0	0	1	0	0
35	1	0	1	10	2	0	0	0	0	1	0	0
36	0	0	1	27	4	0	0	0	0	0	0	0

TABLE 4 *(continued)*

Springbok No.	*Hippobosca rufipes*	*Lipoptena sepiacea*	*Rhinoestrus antidorcitis*		*Rhinoestrus vanzyli*		*Amblyomma hebraeum*		*Rhipicephalus evertsi evertsi*		*Boophilus decoloratus*	
			L_2	L_3	L_2	L_3	larvae	adult	larvae	nymphs	larvae	adult
17 September												
37	0	3	0	0	0	1	0	0	0	0	0	0
38	0	0	0	5	0	0	0	0	0	0	0	0
39	0	0	0	1	0	0	0	0	0	0	0	0
29 October												
40	0	5	0	0	0	0	0	0	0	0	0	0
41	0	1	0	0	0	0	0	0	1	6	0	0
42	0	0	0	0	0	0	0	0	2	0	0	0
43	0	1	0	0	0	0	0	0	0	0	0	0
3 December												
44	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	7	2	0	0
47	0	0	0	0	0	0	0	0	1	0	0	0
48	0	0	0	0	0	0	0	0	1	0	0	0

The dominant species was *Damalinia antidorcus* present in 47 of the 48 springbok examined followed by *Linognathus antidorcitis* in 43, *Linognathus euchore* in 32 and *Linognathus armatus* in 29, respectively.

Of minor importance was *Linognathus bedfordi* and *Linognathus digitalis*, which were present in only 16 and 9 springbok, respectively (Table 3).

The total lice burden showed a minor peak in February, fell steadily in autumn, started rising in June, increased sharply in August, reached a peak in September and then fell to a very low level in December (Fig. 1).

The marked increase in late winter and spring is due largely to nymphs. The dominance of nymphs throughout the year, however, is obvious when their numbers are compared with those of adults (Table 3 and Fig. 1).

Dominant lice species

D. antidorcus (Fig. 1). In February there was a false peak (shown in Fig. 1), caused by a total lice burden of 704 in Springbok No. 19 (Table 3). The other 3 animals, however, had only low lice burdens, ranging from 4–21 *D. antidorcus*. The further peaks in August and September are more important, as the numbers of lice in individual animals did not vary to the same extent as those of springbok killed in February.

Linognathus antidorcitis (Fig. 1). The peaks in both August (mean 296) and September (mean 335) were very similar, but subsequently numbers fell dramatically.

Linognathus armatus (Fig. 1). Parasites showed a minor rise in May and a peak in September.

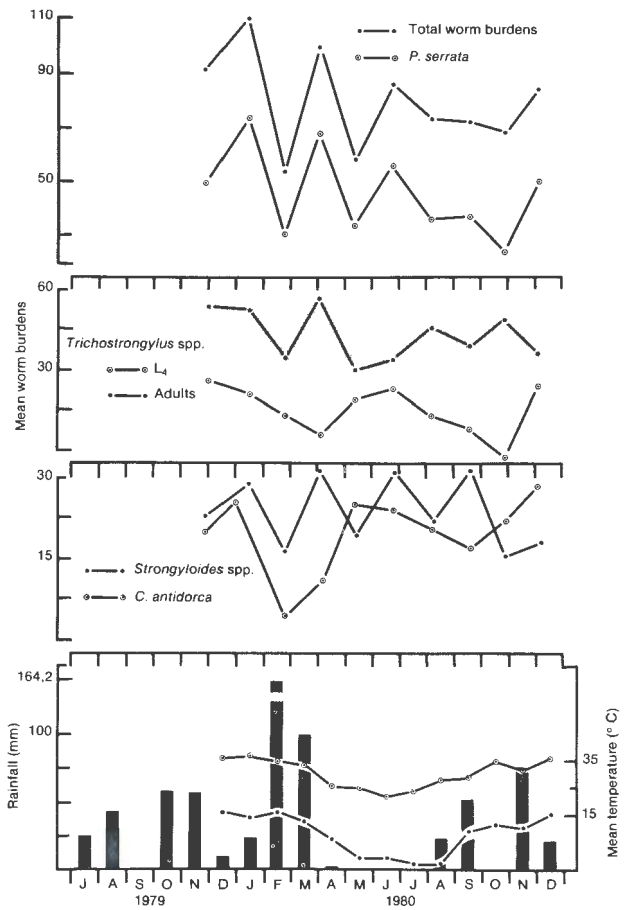

FIG. 2 Variations in total nematode worm burdens and in the total burdens of 4 genera in springbok. Mean maximum and mean minimum temperatures and total monthly rainfall at Benfontein are recorded in the lower graph

Linognathus euchore (Fig. 1). Parasite burdens rose steadily from May to a major peak in September.

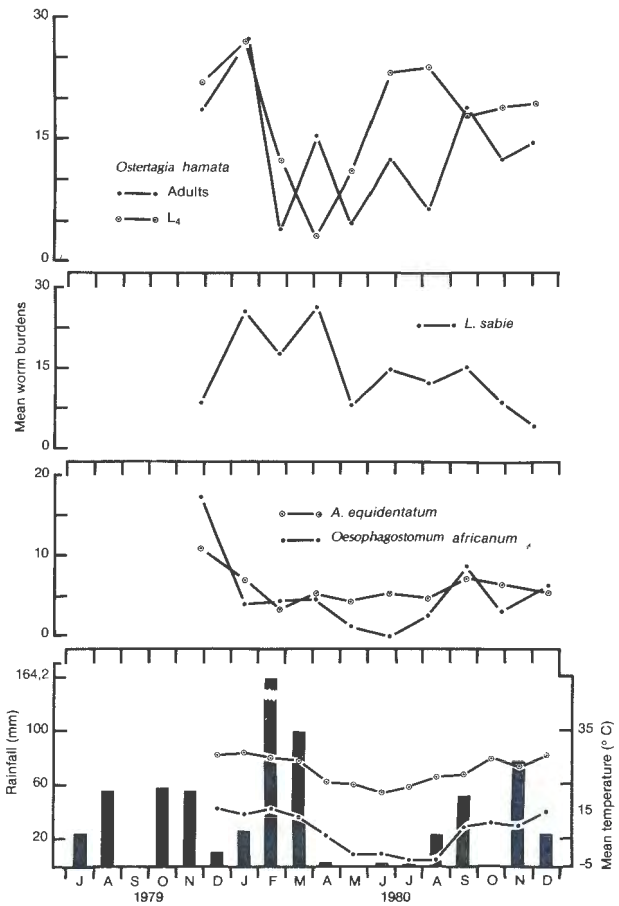

FIG. 3 Variations in the total burdens of 4 nematode genera in springbok. Mean maximum and mean minimum temperatures and total monthly rainfall at Benfontein are recorded in the lower graph

Louse flies

Thirty-four *Lipoptena sepiacea* were recovered from 19 springbok and 4 *Hippobosca rufipes* from 4 springbok only (Table 4).

Nasal bot-flies

Except for 5 animals, all springbok shot in winter or spring (June–September) had 3rd instar *Rhinoestrus antidorcitis*, but only 9 out of 19 animals had 2nd or 3rd instar *Rhinoestrus vanzyli* during this period. Springbok No. 12 and 13, killed in January, were the only slaughtered animals that had these parasites in the period October–May (Table 4).

Ticks

Rhipicephalus evertsi evertsi. Larvae and nymphs were present in 22 springbok.

Boophilus decoloratus. Two springbok had 1 adult each of *B. decoloratus*, and 1 had 2 *Boophilus* sp. larvae.

Amblyomma hebraeum. One springbok had 1 adult and 1 a single larvae both of which were present in April.

Nematodes

The total worm burdens rose to a peak in January, falling gradually with minor peaks until October, only to rise again in December (Fig. 2). The contributors to these fluctuations illustrated in Fig. 2 and 3 were: adults of *Paracooperia serrata, Trichostrongylus* spp., *Strongyloides* spp., *Cooperioides antidorca, Longistrongylus*

TABLE 5 Nematodes recovered at autopsy from springbok at Benfontein. Age group and sex are recorded in Table 3

Springbok No.	*Agriostomum equidentatum*	*Cooperioides antidorca*	*Longistrongylus subtie*	*Oesophagostomum africanum*	*Ostertagia* spp.	*Ostertagia hamata*	*Paracooperia serrata*	*Strongyloides* spp.	*Trichostrongylus* spp.	*Trichostrongylus colubriformis*	*Trichostrongylus falculatus*	*Trichostrongylus minor*	Total
21 July 1979													
1 (1)	50	(1)1 550	0	8	712	250	730	0	0	144	330	8	3 782
2 (1)	13	206	0	0	81	123	590	0	0	240	665	81	1 999
3	16	3	0	(1)12	476	0	980	0	0	70	3	333	1 893
4 (1)	41	80	(1)395	0	477	0	517	0	0	0	2	115	1 627
5	102	1 076	(1)900	(1)120	500	0	9 525	0	0	0	0	4 572	16 795
6	550	2 035	(1)91	0	68	0	821	0	0	540	2 942	704	7 751
Mean	128,67	825,00	231,00	23,33	385,67	62,17	2 193,83	0	0	165,67	657,00	968,83	5 641,11
28 November													
7	172	138	0	0	383	305	2 842	114	970	438	1 519	301	7 182
8	3	0	60	0	404	139	1 305	40	450	0	3 130	499	6 030
9	10	1 398	51	(1)18	763	0	2 438	960	899	1 345	3 440	5	11 327
10	41	0	17	14	434	335	3 965	1 220	676	280	90	599	7 671
11	390	480	275	1 470	564	991	2 054	420	167	1 262	1 530	730	10 333
Mean	123,20	403,20	80,60	300,40	509,60	354,00	2 520,80	550,80	632,40	665,00	1 941,80	426,80	8 508,60
16 January 1980													
12	3	720	59	7	402	289	1 609	160	50	610	640	1 019	5 568
13	23	140	1 144	9	2 129	1 434	6 640	700	235	800	560	793	14 607
14	95	1 799	216	3	580	172	5 205	1 560	662	430	2 039	761	13 522
15	77	0	295	47	113	501	8 512	1 170	900	1 750	1 360	476	15 201
Mean	49,50	664,75	428,50	16,50	806,00	599,00	5 491,50	897,50	461,75	897,50	1 149,75	762,25	12 224,50
20 February													
16	21	87	370	3	63	0	2 515	260	0	660	300	290	4 569
17	0	0	200	0	471	70	981	550	660	840	510	612	4 894
18	2	0	0	(1)59	0	0	0	5	20	0	65	80	231
19	27	4	653	29	75	0	204	280	30	70	20	730	2 122
Mean	12,50	22,75	305,75	22,75	152,25	17,5	925,00	273,75	177,50	392,50	223,75	428,00	2 954,00
2 April													
20	14	0	0	2	2	141	564	0	0	0	40	50	813
21	61	228	1 452	9	0	384	3 757	2 590	0	880	5 120	740	15 221
22	7	191	1 082	21	2	25	6 748	720	210	1 240	2 521	1 060	13 827
23	49	9	452	62	5	500	7 948	1 270	0	1 350	630	170	12 445
24	25	178	503	50	45	80	4 151	500	20	330	1 990	150	8 022
Mean	31,2	121,2	697,8	28,8	10,8	226,0	4 633,6	1 016,0	46,0	760,0	2 060,2	434,0	10 065,6

TABEL 5 *(continued)*

Springbok No.	*Agriostomum equidentatum*	*Cooperioides antidorca*	*Longistrongylus sabie*	*Oesophagostomum africanum*	*Ostertagia* spp.	*Ostertagia hamata*	*Paracooperia serrata*	*Strongyloides* spp.	*Trichostrongylus* spp.	*Trichostrongylus colubriformis*	*Trichostrongylus falculatus*	*Trichostrongylus minor*	Total
13 May													
25	12	60	0	3	35	0	96	430	163	340	250	152	1 541
26	47	2 170	0	4	50	0	3 390	570	28	140	870	155	7 424
27	16	100	0	0	289	40	471	140	1 220	0	0	50	2 326
28	6	180	260	0	152	50	876	400	0	30	530	50	2 534
Mean	20,25	627,5	65,0	1,75	131,5	22,5	1 208,25	385,0	352,75	127,5	412,5	101,75	3 456,25
25 June													
29	37	1 315	220	0	281	590	1 646	153	67	0	382	0	4 691
30	(1) 60	853	160	0	1 690	0	8 768	3 010	2 038	1 590	750	810	19 729
31	15	214	60	0	130	70	872	200	8	130	630	97	2 426
32	12	0	390	0	68	0	1 220	510	54	160	0	274	2 688
Mean	31,0	595,5	207,5	0	542,25	165,0	3 126,5	968,25	541,75	470,0	440,5	295,25	7 383,5
6 August													
33	19	267	280	7	447	0	520	1 050	116	350	880	142	4 078
34	50	1 184	230	19	759	70	1 894	230	250	420	1 100	610	6 816
35	3	230	0	2	214	0	2 169	460	160	1 168	1 480	450	6 336
36	17	10	80	2	855	90	817	300	183	340	1 110	283	4 087
Mean	22,25	422,75	147,5	7,5	568,75	40,0	1 350,0	510,0	177,25	569,5	1 142,5	371,25	5 329,25
17 September													
37	46	634	110	(1) 144	271	380	1 310	190	56	510	1 300	46	4 997
38	18	0	490	50	309	222	2 861	1 860	0	700	470	920	7 900
39	98	298	110	58	345	424	116	940	120	170	510	0	3 189
Mean	54,0	310,67	236,67	84,0	308,33	342,0	1 429,0	996,67	58,67	460,0	760,0	322,0	5 362,0
29 October													
40	13	290	200	8	169	17	395	430	50	220	3 520	400	5 712
41	13	396	0	14	168	90	0	260	0	998	550	632	3 121
42	54	1 300	0	20	1 068	631	1 957	280	0	1 140	2 230	50	8 730
43	4	0	100	0	1	33	90	0	0	30	90	0	348
Mean	21,0	496,5	75,0	10,5	351,5	192,75	610,5	242,5	12,5	597,0	1 597,5	270,5	4 477,75
3 December													
44	19	2 166	0	5	190	259	2 282	330	56	849	2 290	399	8 845
45	31	60	90	20	423	424	3 798	350	840	90	0	1 100	7 226
46	56	1 092	0	0	666	30	3 453	130	0	190	0	360	5 977
47	34	830	0	80	233	132	2 510	720	78	20	0	242	4 879
48	8	0	0	74	323	499	526	49	1 900	97	268	563	4 307
Mean	29,6	829,6	18,0	35,8	367,0	268,8	2 513,8	315,8	574,8	249,2	511,6	532,8	6 246,8

(1) Including 4th stage larvae

sabie, 4th stage larvae (L_4) and adult *Ostertagia hamata*. Adult *Agriostomum equidentatum*, *Oesophagostomum africanum* and L_4 of *Trichostrongylus* spp. started at a high level in November and fell to rise again to peaks in June and December for L_4 of *Trichostrongylus* spp. (Fig. 2) or September for adults of *A. equidentatum* and *Oesophagostomum africanum* (Fig. 3).

TABLE 6 Number of 4th stage larvae of *A. equidentatum*, *C. antidorca*, *L. sabie* and *Oesophagostomum africanum* recovered from Springbok 1–6.

Springbok No.	1	2	3	4	5	6
A. equidentatum	5	13	0	9	0	0
C. antidorca	360	0	0	0	0	0
L. sabie	0	0	0	360	900	21
Oesophagostomum africanum	0	0	12	0	120	0

Other 4th stage larvae

All the springbok shot in July had L_4 of *A. equidentatum*, *C. antidorca*, *L. sabie* and *Oesophagostomum africanum* either as a single species in individual animals or more than 1 species per springbok (Table 6).

Other incidental arthropods

Dr E. M. Nevill of the Veterinary Research Institute found leafhoppers in 3 springbok and a barklouse as well as a sucking bug in a single springbok shot in July 1979.

Climate

The fluctuations in monthly rainfall from July 1979–December 1980 and the mean monthly temperatures are illustrated in Fig. 2 and 3.

Ageing

The criteria used for ageing (Rautenbach, 1971) are modified with correction for ages from marked individuals (Fig. 4).

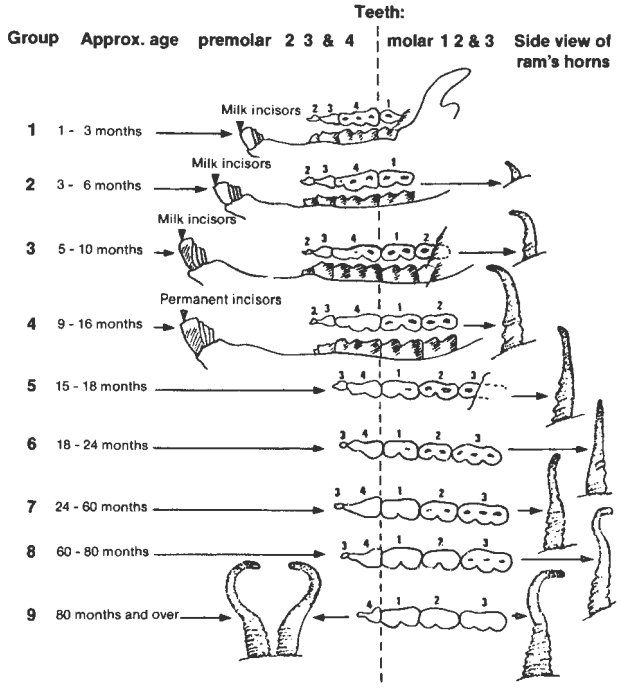

FIG. 4 A guide to the ageing of springbok (from Rautenbach, 1971)

DISCUSSION

Horak *et al.* (1982 a) described the parasites they recovered from 21 springbok shot in game parks in Lichtenburg, Krugersdorp and Swellendam. It should be mentioned that springbok prior to their introduction were not found at Swellendam (De Graaff & Penzhorn, 1976), nor did they occur naturally at Krugersdorp except for short periods. The differences, therefore, in parasite burdens described by Horak *et al.* (1982 a) may have been due to the unnatural habitat. Most of the parasites they recovered were found in the present survey, but we recovered the following additional parasites:

1. Lice: *Linognathus digitalis* and *Linognathus euchore*.
2. Louse flies: *Hippobosca rufipes* and *Lipoptina sepiacea*.
3. Nasal bot-flies: *Rhinoestrus antidorcitis* and *Rhinoestrus vanzyli*.
4. Ticks: *Amblyomma hebraeum* and *Boophilus decoloratus*. Horak *et al.* (1982 a) found larvae and nymphs of *Boophilus* spp. on springbok at Lichtenburg.
5. Nematodes: *Longistrongylus sabie* and *Trichostrongylus minor*.

However, there were other ticks and nematodes found by Horak *et al.* (1982 a) which were not present in this survey (see Introduction above).

Seasonal incidence

Lice

The minor peak in February was due almost entirely to the 704 *D. antidorcus* recovered from Springbok No. 19 which only had 43 lice of other species, when the other 3 springbok killed at the same time had only 284 lice. The 3 springbok killed in September had 1 078, 219 and 1 672 lice, respectively (mean 987,67), and this was the true peak of lice in this study. This was preceded by high burdens in August and also in October. It can be concluded that lice, bred in late winter and spring, remain at a low level in summer and autumn.

Nasal bot-flies

Only Springbok No. 2 in July 1979 and Springbok No. 29 shot in June 1980 were free of nasal bot-flies, whereas all the other 18 springbok killed from June–September were infested. Although Springbok No. 12 and 13 were infested in January, 31 other springbok were free of *Rhinoestrus* spp. in the period October–May. Horak & Butt (1977) recovered *Oestrus mcdonaldi* from blesbok (*Damaliscus dorcas phillipsi)* at Lunsklip in the Northern Transvaal. They postulated that 3rd instar larvae of *Oestrus mcdonaldi* were present only from May–September. Subsequently, Horak, Brown, Boomker, De Vos & Van Zyl (1982b) confirmed that *Oestrus mcdonaldi* in bontebok was confined to the period May–September at Rietvlei (near Pretoria) and Badplaas in the Eastern Transvaal. Moreover, Horak (1977) postulated that *Oestrus ovis* in sheep overwintered as larvae in the nasal and frontal sinuses. Our observations with *Rhinoestrus* spp. in springbok confirm those of Horak (1977). Horak & Butt (1977) and Horak *et al.* (1982 b) that nasal bot-flies with rare exceptions parasitize ruminants only from May–September.

Nematodes

It is obvious that the fluctuations in the total worm burdens (Fig. 2) are mainly due to adults of *Paracooperia serrata*, *Trichostrongylus* spp. *Strongyloides* spp. and *Ostertagia hamata* (Fig. 3). In 1980, the peak worm burdens, recorded in January, were followed by a secondary peak in April in which mean total worm burdens were 12 235 and 10 066, respectively. This represents a mere 17 % difference.

Rain was distributed as follows: In October and November 116,6 mm, December and January 34,6 mm, and in February and March there was a massive increase to 263,4 mm. These spring, summer and autumn rains

were probably responsible for the increase in larval infestation of the veld and accounted for the rise in worm burdens. This total of 414,6 mm for the period October–March exceeds the mean rainfall at Benfontein for this period by 145,3 mm, owing mainly to heavy rain in March and April 1980. Moreover, it even exceeds the mean annual rainfall (405,6 mm) by 9 mm.

If the data for adults of *Longistrongylus sabie* and *Ostertagia hamata* are combined and compared with L_4 of *Ostertagia hamata*, it was only in February, April and September that adults exceeded L_4 (Table 5, Fig. 3).

Horak *et al.* (1982 a) showed L_4 of *Longistrongylus/Ostertagia* group reached a peak in winter in the Transvaal (Lichtenburg and Krugersdorp) and during the summer in the winter rainfall area of Swellendam. They postulated that this was due to arrested larval development (hypobioses) to allow these worms to survive the unfavourable dry conditions in the veld. This was partly confirmed when L_4 of *Ostertagia* sp. reached a peak in June and August in winter, but does not account for their dominance over adults in the summer in the present survey.

In domestic ruminants, *Ostertagia circumcincta* in sheep and goats and *Ostertagia ostertagi* in cattle frequently have a prolonged histotrophic phase which is a normal part of their life cycle, and development may be retarded in the L_4 for as long as 12 weeks before the 4th moult and further development to adults take place (Sommerville 1954). This is a normal part of the life cycle of *Ostertagia* spp. amd may also apply to *Longistrongylus* spp. in springbok.

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