Onderstepoort J. vet. Res., 45, 229–234 (1978)

PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. XI. HELMINTHS IN CATTLE ON NATURAL PASTURES IN THE NORTHERN TRANSVAAL*

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ABSTRACT

HORAK, I. G., 1978. Parasites of domestic and wild animals in South Africa. XI. Helminths in cattle on natural pastures in the northern Transvaal. *Onderstepoort Journal of Veterinary Research*, 45, 229–234 (1978).

After being exposed to infestation for 4 or 6 weeks, pairs of tracer calves were slaughtered to determine the seasonal incidence of helminth infestation in cattle on natural pasture.

Haemonchus placei was recovered from March–July and from November–February, and peak burdens were recorded during December and January. There was marked inhibition in larval development from April–July.

Trichostrongylus spp. were recovered from March–June and from November–February, the greatest number of worms being recorded during December.

Cooperia spp. infestation occurred from March–August and November–February with peak burdens during April–June and December. From February–August more than 50% of the worms recovered were in the 4th larval stage of development.

The greatest number of *Oesophagostomum radiatum* were recovered from June–January. *Longistrongylus sabie* and *Impalaia tuberculata*, parasites normally found in impala, were recovered from many of the survey animals, this being the first record of their occurrence in cattle.

Résumé

PARASITES DES ANIMAUX DOMESTIQUES ET SAUVAGES EN AFRIQUE DU SUD. XI. HELMINTHES DU BÉTAIL SUR DES PÂTURAGES NATURELS DU NORD DU TRANSVAAL

Afin de déterminer l'incidence saisonnière de l'infestation helminthique du bétail sur pâturages naturels, des paires de veaux marqueurs ont été exposés à l'infestation pendant 4 *à* 6 *semaines et sacrifiés ensuite.*

On a retrouvé Haemonchus placei *de mars à juillet et de novembre à février avec charges maximales en décembre-janvier et une inhibition marquée du développement larvaire d'avril à juillet.*

Les diverses espèces de Trichostrongylus *ont été récupérées de mars à juin et de novembre à février, le plus grand nombre de vers ayant été observé en décembre.*

L'infestation à Cooperia *spp. s'est manifestée de mars à août et de novembre à février avec des charges maximales d'avril à juin et en décembre. De février à août plus de la moitié des vers récupérés se trouvaient au* 4*e stade larvaire de leur développement.*

Les plus grands nombres d' Oesophagostomum radiatum *ont été trouvés de juin à janvier. Chez beaucoup des animaux inspectés on a également trouvé* Longistrongylus sabie *et* Impalaia tuberculata: *ces vers parasitent normalement l'impala et c'est la première fois qu'on en trouve chez le bétail.*

INTRODUCTION

The seasonal incidence of helminth infestation on irrigated pastures on the Transvaal Highveld has been determined by the regular slaughter of tracer calves (Horak & Louw, 1978). Although many cattle in South Africa graze irrigated pastures, the majority graze either artificially established dryland or natural pastures. The savanna regions of the Transvaal in particular are used for grazing large herds of beef cattle but to date no surveys, based on worm counts at necropsy, have been conducted in cattle in these regions.

Besides cattle, antelope also make use of the pasturage on many farms. The seasonal fluctuations of helminth infestation in blesbok and impala have already been determined in separate surveys conducted in the northern Transvaal (Horak, 1978b, 1978c).

The present paper describes a helminth survey conducted in cattle grazing with impala in the Boekenhout area on the Nylsvley Nature Reserve (24° 29′S; 28° 42′E; Alt. ±1 110 m), in the mixed bushveld of the northern Transvaal. This reserve belongs to the Department of Nature Conservation of the Transvaal Provincial Administration and the portion utilized in the survey served as the study area of the South African Savanna Ecosystem Project.

The survey area of 750 ha is situated in an important beef cattle ranching region and it is here that the survey in impala was conducted (Horak, 1978c). The results are thus applicable to cattle grazed in a large area of the Transvaal and also afford the opportunity of assessing the degree of cross-infestation that takes place between impala and cattle sharing the same habitat.

MATERIALS AND METHODS

Pastures

The survey area of 750 ha grazing was divided by wire fences into 4 unequal camps. The vegetation consisted of trees, among which *Burkea africana* predominated, shrubs, chiefly *Ochna pulchra* and *Grewia flavescens* and a herbaceous layer consisting mainly of the grasses *Eragrostis pallens* and *Digitaria eriantha* (Hirst, 1975).

For decades cattle have grazed this particular area from mid-January to mid-May since the abundance of green grass makes the poisonous plant *Dichapetalum cymosum* less attractive during these months. At other times *D. cymosum* is more abundant or more attractive, made so by the poor grass cover, and no cattle were allowed to graze during these times.

Infestation

Approximately two hundred 10–12-month-old cattle were brought into the study area during January 1976. About half of these animals were not treated

* This survey forms part of the South African Savanna Ecosystem Project

Received 4 July 1978—Editor

with an anthelmintic while grazing the study area, while half of the remainder were treated once and the other half at regular 2-week intervals. Except for a few animals all the cattle were removed during the first week of May 1976. Six of the untreated cattle served as a source of infestation in the study area throughout the survey.

From May 1976–February 1977 a group of at least 8 untreated cattle grazed the survey area and served as a source of pasture contamination. During January 1977 two hundred and fifty 8–10-month-old calves from neighbouring farms were introduced into the study area and remained there until the completion of the survey.

Tracer cattle

Of the 24 oxen used to monitor infestation in the study area, 16 were selected from the 200 animals which had originally grazed this area, while the other 8 came from an adjacent farm.

The animals were divided into pairs and each pair was drenched with parbendazole at approximately 80 mg/kg live mass 4 weeks prior to slaughter. The animals slaughtered during August 1976 and January 1977, however, were drenched 6 weeks before slaughter. Only 1 animal of the pair was slaughtered during August as the other had escaped and could not be found for 2 weeks.

Helminth recovery and counting techniques

At necropsy the oesophagus was opened and macroscopically examined for *Gongylonema* spp. The rumen was then opened and any paramphistomes adhering to its walls or present on the surface of the ruminal contents were collected. The trachea and the bronchial tree of the right lung only were opened next and thoroughly washed, the washings being collected on a sieve with 38 μm apertures.

One 1/5th aliquot of the abomasal and of the small intestinal contents was sieved and collected separately on sieves with 38 μm apertures and two 1/5th aliquots of the large intestinal contents were sieved and collected on sieves with 150 μm apertures. The mucosa of the abomasum, small intestine and large intestine was scraped separately with glass slides and, after being subjected to pepsin/HCl digestion, the scrapings were sieved and collected on sieves with 38 μm apertures. The contents of all the sieves were preserved with formalin, and stored.

The worm burdens of the tracer cattle were calculated from the total counts made of the worms in the rumens and digested material and from counts done on aliquots of the gastro-intestinal ingesta.

General

At approximately 14-day-intervals faeces for faecal worm egg counts were collected from the 6 animals which served as a source of infestation in the study area. After the counts had been completed, the feaces were mixed and a single faecal culture for larval differentiation was made.

Minimum and maximum atmospheric temperatures and rainfall were recorded daily in the survey area.

Results

The total worm burdens of the animals are summarized in Table 1, while the monthly mean burdens of the major genera and the percentage of *Haemonchus placei* and *Cooperia* spp. in the 4th larval stage are summarized in Table 2. Percentages are not given for *Trichostrongylus* spp., because of the comparatively small number of larvae recovered at every count, or for *Oesophagostomum radiatum,* since the 4th moult occurs 19 days after infestation (Andrews & Maldonado, 1941) and the majority of worms were therefore still larvae.

The monthly mean total and differentiated faecal worm egg counts of the cattle which served as a source of infestation and the atmospheric temperature and rainfall in the survey area are graphically represented in Fig. 1.

Haemonchus placei: Worms of this species were recovered from every animal slaughtered from March–July and from November–February, and peak total worm burdens were recorded during December and January. Not a single animal was infested from August–October. Adult worms outnumbered 4th stage larvae from November–January, but from March–July more than 80% of the total burden consisted of 4th stage larvae. Peak egg counts were recorded from November 1976–February 1977.

Longistrongylus sabie: This nematode was recovered in small numbers from individual animals from March–June and from November–January. Peak burdens occurred during March and December.

Trichostrongylus spp.: *Trichostrongylus colubriformis* and *Trichostrongylus falculatus* were recovered and 2 animals harboured *Trichostrongylus axei.* Every animal slaughtered during March, May, November and December was infested with worms of this genus and peak burdens were recorded during December. Peak egg counts were recorded in June 1976 and during January and February 1977.

Cooperia spp.: Both *Cooperia pectinata* and *Cooperia punctata* were present and every animal slaughtered from March–August and from November–February was infested. Peak total burdens were recorded from April–June and in December, adults outnumbering 4th stage larvae from November–January. The proportion of worms in the 4th larval stage increased from 50%–100% from April–August. Large percentages of 4th stage larvae were, however, also encountered during March and February. Peak egg counts were recorded during May 1976.

Impalaia tuberculata: Ten animals were infested with this nematode, every animal examined during March, April, November and December being infested. Infective larvae were recovered from cattle faecal cultures made during February 1976 before the first animals in the survey were slaughtered.

Oesophagostomum radiatum: Helminths of this species were recovered from every animal, peak burdens occurring in August and during December and January. Peak egg counts were recorded during September and October 1976.

General: One animal slaughtered during January harboured 1 *Moniezia benedeni.* Although the rumens of 9 cattle contained adult paramphistomes, no worms were recovered from the lungs, liver or oesophagus of any of the animals. The carcass of 1 animal slaughtered during June exhibited lesions typical of *Parafilaria bovicola* infestation, but no worms were recovered.

The highest maximum temperatures were recorded from November 1976–February 1977 and the lowest minimum temperatures during June and July. No rain fell from June–August.

TABLE 1 The total worm burdens of tracer cattle at Nylsvley

Animal No.	Date slaughtered	Number of helminths recovered													
		H. placei		*L. sabie*		*Trichostrongylus* spp.			*Cooperia* spp.			*I. tuberculata*		*O. radiatum*	
		4th	Adult	4th	Adult	4th	*T. colubriformis*	*T. falculatus*	4th	*C. pectinata*	*C. punctata*	4th	Adult	4th	Adult
	1976														
1.....	11 Mar.....	56	25	10	50	0	60	90	500	50	0	225	0	3	5
2.....	11 Mar.....	732	75	72	28	100	100	101	541	75	50	350	0	0	5
3.....	8 Apr.....	644	0	0	0	50	0	75	1 734	656	884	165	0	3	0
4.....	8 Apr.....	475	0	0	1	0	0	0	1 181	725	578	50	0	5	5
5.....	6 May.....	477	0	0	0	0	77	6	1 171	306	456	0	0	3	6
6.....	6 May.....	275	0	1	0	0	6	0	203	110	124	0	0	3	3
7.....	3 Jun.....	520	0	0	0	275	0	225	1 800	425	450	1 103	0	79	13
8.....	3 Jun.....	576	0	50	0	0	0	0	1 578	225	278	0	0	0	10
9.....	2 Jul.....	205	0	0	0	0	0	0	775	0	150	0	0	0	5
10.....	2 Jul.....	175	0	0	0	0	0	0	250	1	50	0	0	100	20
11**.....	12 Aug.*.....	0	0	0	0	0	0	0	25	0	0	25	0	169	199
12.....	9 Sep.....	0	0	0	0	0	3	3	0	0	0	0	0	31	13
13.....	9 Sep.....	0	0	0	0	0	0	0	0	0	0	0	0	109	5
14.....	7 Oct.....	0	0	0	0	0	0	0	0	0	0	0	0	56	1
15.....	7 Oct.....	0	0	0	0	0	0	0	0	0	0	0	0	26	14
16.....	4 Nov.....	0	50	1	0	50	125	0	250	325	50	250	0	25	20
17.....	4 Nov.....	50	200	0	0	100	282	81	225	400	50	25	0	75	3
18.....	1 Dec.....	425	500	0	0	325	901	225	1 225	900	700	0	25	125	5
19.....	1 Dec.....	775	1 100	450	75	200	3 137	425	1 625	1 434	425	1 100	1 675	125	3
	1977														
20**.....	13 Jan.....	275	1 200	4	28	0	603	0	100	125	525	0	0	105	150
21**.....	13 Jan.....	225	729	0	0	0	0	0	50	150	125	0	0	67	78
22.....	11 Feb.....	457	225	0	0	0	0	0	275	106	53	0	0	5	23
23.....	11 Feb.....	175	150	0	0	25	3	0	153	0	0	0	0	0	10

* A single animal was slaughtered on 12 August ** Exposed for 6 weeks 4th=4th stage larvae

TABLE 2 The monthly mean worm burdens of tracer cattle at Nylsvley

Month	Mean worm burdens					
	H. placei		*Trichostrongylus* spp.	*Cooperia* spp.		*O. radiatum*
	Total	% 4th	Total	Total	% 4th	Total
1976						
Mar.	444	88,7	226	608	85,6	7
Apr.	560	100,0	63	2 879	50,6	7
May	376	100,0	45	1 185	58,0	8
Jun.	548	100,0	250	2 378	71,0	51
Jul.	190	100,0	0	613	83,6	63
Aug.*	0	—	0	25	100,0	368
Sep.	0	—	3	0	—	79
Oct.	0	—	0	0	—	49
Nov.	150	16,6	319	650	36,5	62
Dec.	1 400	42,9	2 607	3 155	45,2	129
1977						
Jan.*	1 215	20,6	302	538	14,0	200
Feb.	504	62,8	14	294	72,9	19

* Exposed for 6 weeks 4th=4th stage larvae

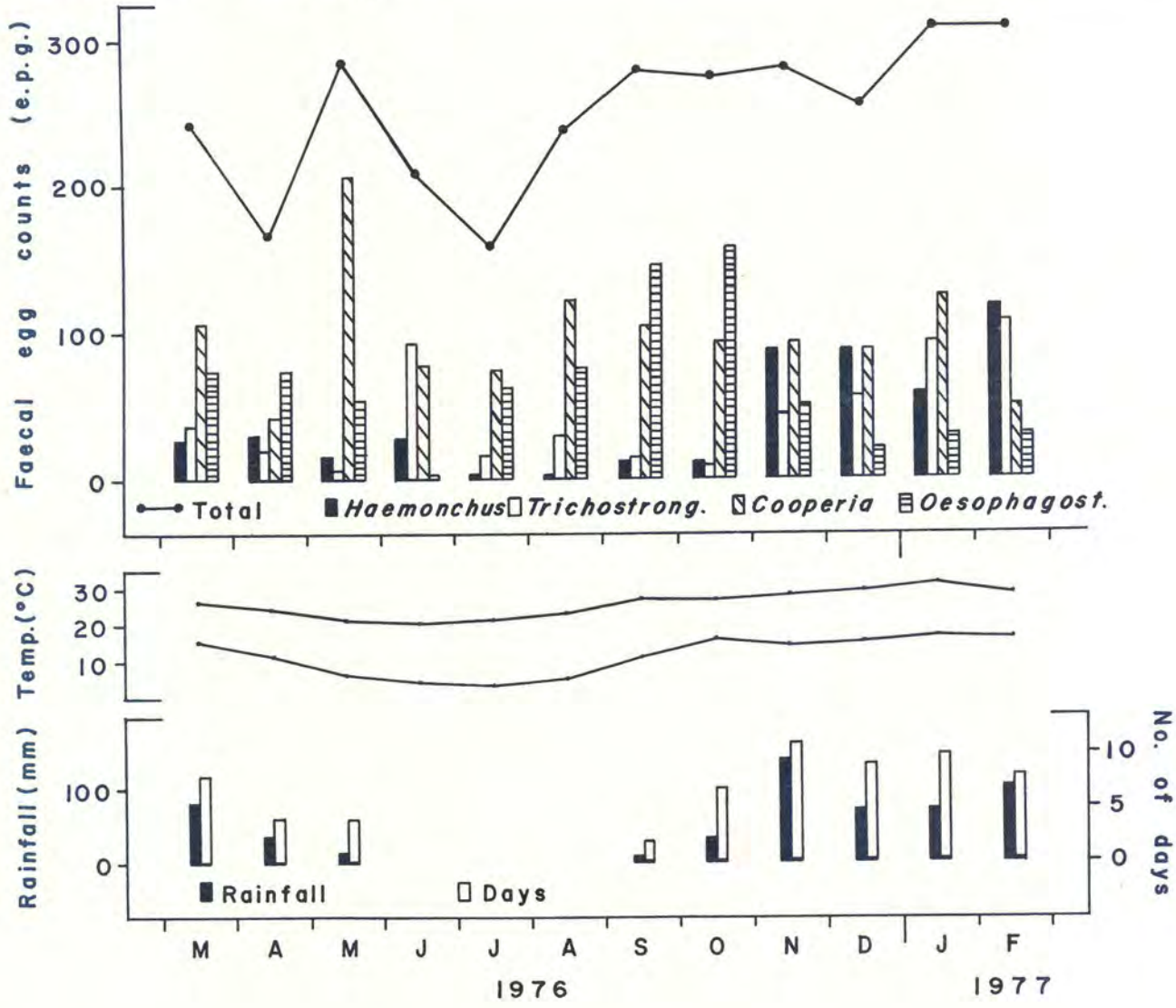

FIG. 1 Total and differential faecal worm egg counts of infested cattle, atmospheric temperature and rainfall in the survey area

Discussion

The results of this survey are comparable with those obtained in a similar survey conducted in calves on irrigated, artificially-established pastures at Hennops River on the Transvaal Highveld (Horak & Louw, 1978) and in a survey in impala at Nylsvley during the year prior to this survey (Horak, 1978c).

Haemonchus spp. were recovered throughout the year at Hennops River. There the peak burdens recorded in the calves slaughtered during July were followed by a progressive decrease until October and then rose to a minor peak in December. In the present survey the *H. placei* burdens followed a pattern basically similar, except that in this case the major peak was reached during December and January while the minor peak occurred from April–June, and no worms were recovered from August–October.

In the impala it was not possible to determine when the helminths in a particular animal had been acquired because the animals were continuously exposed to infestation. Nevertheless, it is apparent that the seasonal incidence of *H. placei* infestation in the 2 host species at Nylsvley differed considerably during certain months. The infestation acquired by the cattle from April–July did not develop further than the 4th larval stage, thus, in continuously exposed animals, the number of worms could be expected to remain constant or to increase without the worms reaching adulthood during these months. That this did indeed happen in the impala culled from April–September indicates that the acquisition of infestation in the 2 host species was similar during this period. The major difference occurred in the period December–February in which the highest burdens of *H. placei* were recorded in the cattle and the lowest in the impala.

A possible explanation for this difference is that during these months fairly large numbers of adult *L. sabie* were present in the impala, thus making the abomasal environment unsuitable for the survival of newly acquired *H. placei* larvae. The cattle acquired only modest numbers of *L. sabie* and, since few developed to adulthood, competition between the species apparently did not occur. Competition between *T. axei* and *H. contortus* to the detriment of the latter species has been described in sheep by Turner, Kates & Wilson (1962) and Reinecke (1974).

At Hennops River the greatest number of *Trichostrongylus* spp. was recorded during June while the worm burdens from July–September were very low. At Nylsvley the largest burdens were recovered from the cattle during December while few or no worms were present from July–October. This nematode is usually present in larger numbers during the cooler months of the year (Reinecke, 1964; Muller, 1968; Viljoen, 1969), but the extremely dry conditions prevailing at Nylsvley during these months must have contributed to its disappearance from the pastures. Similar observations have been made in sheep during a dry winter at Outeniqua in the Cape Province (Snijders, Stapelberg & Muller, 1971). In the Karoo, however, Viljoen (1969) recovered the greatest number of *T. falculatus* from tracer lambs during the autumn and winter months despite the virtual absence of rain. He concluded that when the mean monthly mean temperature exceeded 20 °C, rainfall, even if it exceeded 50 mm a month, resulted only in a very slight increase in *T. falculatus* burdens. In the present survey the mean monthly mean temperatures exceeded 20 °C during November and December and yet the largest *T. colubriformis* and *T. falculatus* burdens were recovered from the cattle slaughtered during December.

In the cattle at Hennops River, peak *Cooperia* spp. burdens were present during May and June and very low numbers from July–January. At Nylsvley, the peak numbers present from April–June were followed by the complete absence of parasites during September and October and then by a major peak in December. In the impala the seasonal fluctuations in the *Cooperia* sp. and *Cooperioides* spp. burdens were similar to those in cattle, excepting that the first peak occurred later, namely, from July–September.

In the present survey the inhibition of the development of *H. placei* in the 4th larval stage, a constant feature in surveys conducted in sheep and calves in the Transvaal (Horak, 1978a; Horak & Louw, 1977, 1978), was most marked from March–July. This inhibited development serves to keep the parasites alive in a stable internal environment while conditions on the pasture would be unsuitable for their survival or development to the infective stage.

The fact that in the above-mentioned surveys *Haemonchus* spp. were recovered throughout the year, albeit generally in smaller numbers from approximately July–November, indicates that their survival on the pastures was still possible. At Nylsvley, however, since no *H. placei* were recovered from the cattle slaughtered during August–October, development to the infective stage or survival on the pasture would seem to be impossible during these months. Inhibition in development in the host during the preceding months, when larvae were still available on the pasture, was therefore a very real necessity to bridge this period.

Muller (1968) has suggested that *Trichostrongylus* spp. exhibit inhibition of development in the 5th stage during the winter months. No attempt was made, however, in this survey to differentiate 5th stage from adult worms. Although retarded development was present in the *Cooperia* spp. burdens, it was not as obvious as that in the case of *H. placei*.

The greatest numbers of *O. radiatum* were recovered from the calves slaughtered from June–January. It seems remarkable that the free-living stages of this parasite could survive during August–October, months that were particularly unfavourable for the acquisition of all other helminths. In a study on the epizootiology of helminth infestation in calves in the north-western Cape Province, Reinecke (1960) found that egg counts of *O. radiatum* reached their maximum during winter and that at necropsy this species was more plentiful during winter than at any other time. He suggested, however, that these calves had become infested during the summer and autumn, a theory which may have to be reinvestigated in the light of the present findings.

Gerber (1975) demonstrated that *O. radiatum* can become established after percutaneous infestation. It is possible that infestation at Nylsvley survived during the dry months of the year in the moist soil round a drinking place in a small marshy area, and that the cattle became infested while standing in this soil. This could possibly account for the presence of this parasite in the cattle during those months when all other helminth counts were at a low level or absent.

The presence in the tracer cattle of *L. sabie* and *I. tuberculata*, parasites normally found in impala (Mönnig, 1923, 1933; Horak, 1978c), confirms the results of experiments in which these parasites were artificially

transmitted to calves (Horak, unpublished data). The generally small number of helminths of these species recovered in this survey and from the cattle in the cross-transmission experiments indicates, however, that cattle are not good alternative hosts for these parasites.

Neither of these helminths was recovered from July–October in any of the animals except 1. This finding agrees with that in a survey conducted in impala at Nylsvley in which the worm burdens of young buck indicated that infective larvae of these parasites were absent on the pastures from June–September (Horak, 1978c).

The fact that most parasites of nearly all species were recovered during December is possibly the result of the warm weather and abundant rainfall during November. Similar temperatures and rainfall during February 1976, however, did not result in very large worm burdens in the animals slaughtered during March. The former observation differs from the seasonal fluctuations in worm burden recorded at Hennops River where the greatest numbers of *Haemonchus* spp. were recovered during July and of *Trichostrongylus* spp. and *Cooperia* spp. during June (Horak & Louw, 1978). The year-round irrigation, climate and nature of the artificial pastures at Hennops River probably account for this difference.

The paramphistomes recovered from the rumens of some of the animals had probably been acquired before the animals had been brought into the study area, as no suitable habitat for the intermediate host, a fresh-water snail, existed in the survey area.

The results of this survey would indicate that drenching cattle at Nylsvley and in similar areas of the Transvaal during July or August would have the greatest effect on infestation. It would rid the animals of inhibited *H. placei* and of *Trichostrongylus* spp. and *Cooperia* spp. as well as newly acquired *O. radiatum*. In the absence of further infestation on the pasture, except that due to *O. radiatum*, these animals would be virtually worm-free until November. Treatment in December would forestall the rise of all species and another treatment in March or April would be effective against the late summer burdens of *H. placei* and *Cooperia* spp.

Acknowledgements

This survey was made possible by the financial support of the National Programme for Environmental Science of the Council for Scientific and Industrial Research. I wish to thank Mr J. M. Smit who loaned the cattle used to contaminate the pasture and Mr P. Osborn who supervised their management.

I am also sincerely grateful to Miss C. Brückner and Mr I. L. de Villiers for their assistance in processing the necropsies.

References

ANDREWS, J. S. & MALDONADO, J. F., 1941. The life history of *Oesophagostomum radiatum*, the common nodular worm of cattle. *Research Bulletin of the Puerto Rico University Agricultural Experiment Station*, No. 2.

GERBER, H. M., 1975. Percutaneous infestation of calves and lambs with *Oesophagostomum* spp. *Journal of the South African Veterinary Association*, 46, 273–275.

HIRST, S. M., 1975. Savanna Ecosystem Project—progress report 1974/75. *South African National Scientific Programmes Report*, 3, 27 pp.

HORAK, I. G., 1978a. Parasites of domestic and wild animals in South Africa. V. Helminths in sheep on dryland pasture on the Transvaal Highveld. *Onderstepoort Journal of Veterinary Research*, 45, 1–6.

HORAK, I. G., 1978b. Parasites of domestic and wild animals in South Africa. IX. Helminths in blesbok. *Onderstepoort Journal of Veterinary Research*, 45, 55–58.

HORAK, I. G., 1978c. Parasites of domestic and wild animals in South Africa. X. Helminths in impala. *Onderstepoort Journal of Veterinary Research*, 45, 221–228.

HORAK, I. C. & LOUW, J. P., 1977. Parasites of domestic and wild animals in South Africa. IV. Helminths in sheep on irrigated pasture on the Transvaal Highveld. *Onderstepoort Journal of Veterinary Research*, 44, 261–270.

HORAK, I. G. & LOUW, J. P., 1978. Parasites of domestic and wild animals in South Africa. VI. Helminths in calves on irrigated pastures on the Transvaal Highveld. *Onderstepoort Journal of Veterinary Research*, 45, 23–28.

MÖNNIG, H. O., 1923. On some new South African parasitic nematodes. *Transactions of the Royal Society of South Africa*, 11, 105–117.

MÖNNIG, H. O., 1933. Wild antelopes as carriers of nematode parasites of domestic ruminants—Part III. *Onderstepoort Journal of Veterinary Science and Animal Industry*, 1, 77–92.

MULLER, G. L., 1968. The epizootiology of helminth infestation in sheep in the south-western districts of the Cape. *Onderstepoort Journal of Veterinary Research*, 35, 159–194.

REINECKE, R. K., 1960. A field study of some nematode parasites of bovines in a semi-arid area, with special reference to their biology and possible methods of prophylaxis. *Onderstepoort Journal of Veterinary Research*, 28, 365–464.

REINECKE, R. K., 1964. Epizootiology and control of nematode parasites of sheep. *Journal of the South African Veterinary Medical Association*, 35, 603–608.

REINECKE, R. K., 1974. Studies on *Haemonchus contortus*. I. The influence of previous exposure to *Trichostrongylus axei* on infestation with *H. contortus*. *Onderstepoort Journal of Veterinary Research*, 41, 213–216.

SNIJDERS, A. J., STAPELBERG, J. H. & MULLER, G. L., 1971. Low level thiabendazole administration to sheep. I. Susceptibility of medicated sheep to natural infestations at Outeniqua. *Journal of the South African Veterinary Medical Association*, 42, 155–167.

TURNER, J. H., KATES, K. C. & WILSON, G. I., 1962. The interaction of concurrent infections of the abomasal nematodes, *Haemonchus contortus*, *Ostertagia circumcincta* and *Trichostrongylus axei* (Trichostrongylidae) in lambs. *Proceedings of the Helminthological Society of Washington*, 29, 210–216.

VILJOEN, J. H., 1969, Further studies on the epizootiology of nematode parasites of sheep in the Karoo. *Onderstepoort Journal of Veterinary Research*, 36, 233–264.

Printed by and obtainable from The Government Printer, Private Bag X85, Pretoria, 0001