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SOME HELMINTH AND ARTHROPOD PARASITES OF THE GREY DUIKER, *SYLVICAPRA GRIMMIA*

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ABSTRACT

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Sixteen grey duikers were culled on the farm Riekert's Laager in the central Transvaal at irregular intervals from May 1979—March 1981. One trematode species, 3 cestode species and 16 nematode species were recovered from these animals. Of these the following are new helminth records for this antelope: *Cooperia hungi, Cooperia neitzi, Cooperia pectinata, Trichostrongylus axei, Trichostrongylus colubriformis, Trichostrongylus falculatus, Trichostrongylus instabilis, Impalaia tuberculata, Nematodirus* sp. and *Paramphistomum* sp.

In addition, 6 species of ixodid ticks were collected. These, in order of abundance, were *Amblyomma hebraeum* (55,9 %), *Rhipicephalus appendiculatus* (36,6 %), *Rhipicephalus evertsi evertsi* (5,1 %), *Boophilus decoloratus* (2,3 %), *Boophilus microplus* (0,05 %) and *Haemaphysalis* sp. (0,05 %). Only 60 (2,8 %) of the 2 118 ticks that were collected were adults. Of the 3 species of lice that were recovered, *Linognathus zumpti zumpti* was most abundant (58,9 %), but, out of a total of 1 498 collected, 1 496 occurred on 1 animal only. *Linognathus breviceps* constituted 29,5 % and *Damalinia lerouxi* 11,6 % of the total. A total of 277 specimens of the hippoboscid fly *Lipoptena paradoxa* were collected from 12 of the 16 animals examined.

Trends in the seasonal fluctuation of *Haemonchus, Trichostrongylus, Impalaia, Lipoptena* and the immature stages of *Amblyomma* and *R. appendiculatus* are graphically illustrated.

INSTRUCTIONS

Grey duikers, *Sylvicapra grimmia,* are small antelope occurring in Africa south of the Sahara that inhabit almost any habitat except desert and dense forest. Because they are largely nocturnal and very adaptable, their chances of establishing themselves are enhanced, even in areas where other species have been exterminated (Dorst & Dandelot, 1972). Child & Wilson (1964) found that grey duikers not only survived but actually increased in numbers in areas where other antelope were exterminated during tsetse fly eradication campaigns. They are even able to survive in areas of dense human settlement and will often enter cultivated lands and vegetable gardens to feed (Dorst & Dandelot, 1972).

The feeding habits and preferred foodplants of grey duikers were first reported by Van der Schijff (1959) from animals observed in the Kruger National Park. Wilson & Clark (1962) expanded on these observations and found that grey duikers are browsers, utilizing the leaves, flowers and fruits of 36 species of trees. Mushrooms are also consumed and forbs make up a substantial amount of the diet (Wilson & Clark, 1962; Wilson, 1966). Hofmann (1973) found that whole sodom apples (*Solanum* spp.) are consumed occasionally, a finding that we confirmed. Wilson & Clark (1962) found a few grass leaves in the rumens of only 4 out of 150 animals examined and concluded that they seldom eat grass. Keep (1969), however, stated that grey duikers in Natal utilize a mixed diet which consists of grass and leaves, and is similar to that of impala.

During the period May 1979–April 1981, 16 grey duikers were culled on the farm Riekert's Laager in order to study their digestive physiology. Their parasites were collected at the same time and are reported on in this paper.

A check-list of the helminth parasites of grey duikers in Africa is given by Round (1968). Sobrero (1975) added *Schistosoma bovis* from East Africa to this list, and Graber (1978) the larval form of *Taenia hyaenae* from Ethiopia. Records of helminths from grey duikers from the Republic of South Africa are given by Gough (1908), Mönnig (1924, 1928), Baer (1925, 1926), Thwaite (1927), Kreiss (1938, 1939), Ortlepp (1961), Round (1968) and Keep (1969).

The ixodid ticks of grey duikers from other countries in Africa are recorded by various authors (Hoogstraal, 1956; Theiler, 1962; Yeoman & Walker, 1967; Keymer, 1969; MacLeod, 1970; Walker, 1974; MacLeod, Colbo, Madbouly & Mwanaumo, 1977), while those occurring in South Africa are listed by Hoogstraal (1956), Theiler (1962) and Baker & Keep (1970). Zumpt (1966) recorded the various flies and Ledger (1980) the lice that occur on these animals.

MATERIALS AND METHODS

The study area was the farm Riekert's Laager in the Cullinan district, central Transvaal (24°30′S 28°29′E). It comprises 1 200 ha and is about 1 410 m above sea-level. The mean annual rainfall for the period June 1978–July 1981 was 440 mm, which fell during October–March. The vegetation is diverse and Acocks (1975) recognizes 3 veld types in this area: Springbok Flats Turf Thornveld, Kalahari Thornveld and Mixed Bushveld.

A number of antelope occur naturally on this farm. They are greater kudu *Tragelaphus strepsiceros,* impala *Aepyceros melampus,* steenbok *Raphicerus campestris,* and grey duikers, while mountain reedbuck *Redunca fulvorufula,* which inhabit the low hills that surround the farm, are occasional visitors. Blue wildebeest *Connochaetes taurinus,* gemsbok *Oryx gazella,* waterbuck *Kobus ellipsiprymnus* and blesbok *Damaliscus dorcas phillipsi* were introduced during 1978 and 1979.

In 1978, 255 cattle were also present on the farm, but these were reduced to 11 during 1979, and at the conclusion of this study in April 1981, there were 64 head. The cattle were dosed sporadically with anthelmintics. During 1978 the cattle were dipped occasionally, but from January 1980 onwards they were dipped at weekly intervals.

A total of 16 grey duikers were culled at irregular intervals. None were shot during December, as this is their lambing season on Riekert's Laager, and, despite numerous serious attempts, none could be found during April and June of either years.

Their lungs, hearts and livers were processed as described by Horak (1978 a), and the abomasa, the small and the large intestines as described by Reinecke (1973). Because the ruminal and caecal contents from 8 of the animals were used for digestive physiology studies, the parasites in these organs could not be included in this

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study. The ruminal contents of the remaining 8 animals were examined in their entirety, as described by Horak (1978 b), and the caecal contents were included with the large intestines.

One aliquot, representing 1/10th of the volume of the ingesta, was made separately for each of the abomasa, the small intestines and the large intestines, and examined microscopically. The entire digests, as well as the lung, heart and liver washings, were examined microscopically.

Most of the adult worms were identified according to the descriptions of the authors listed in Table 1. In cases where more than 1 species of a genus were encountered, the males were identified specifically, but not the females. The 4th stage larvae were identified to generic level only.

The entire hides of the heads, the bodies and the legs below the knee and hock joints, with the hide intact, were immersed in amitraz [Triatix, Coopers S.A. (Pty) Ltd] for approximately 1 hour. They were then processed and the parasites collected as described by Horak, Meltzer & De Vos (1982).

RESULTS

Helminths

The helminths recovered from each antelope are listed in Table 2, and the number of animals positive, the total worm burdens and their mean numbers in Table 3. Trends in the seasonal variation of the 3 major nematode genera, *Haemonchus, Trichostrongylus* and *Impalaia,* are illustrated in Fig. 1–3.

The survey yielded the following 10 new helminth records for the grey duiker: *Cooperia hungi, Cooperia neitzi, Cooperia pectinata, Trichostrongylus axei, Trichostrongylus colubriformis, Trichostrongylus falculatus, Trichostrongylus instabilis, Impalaia tuberculata,*

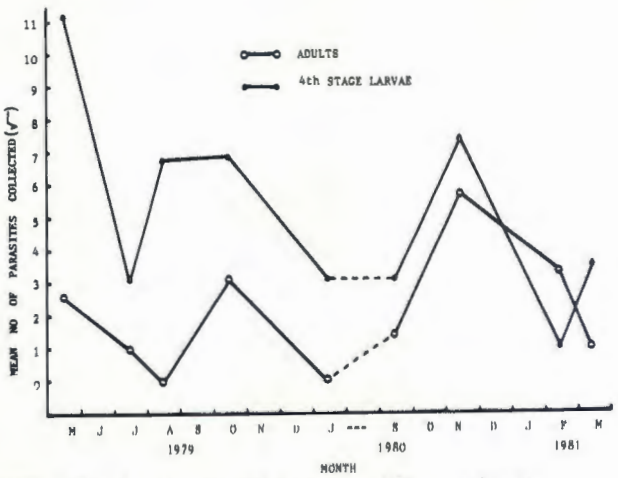

FIG. 1 Trends in the seasonal abundance of *Haemonchus* spp.

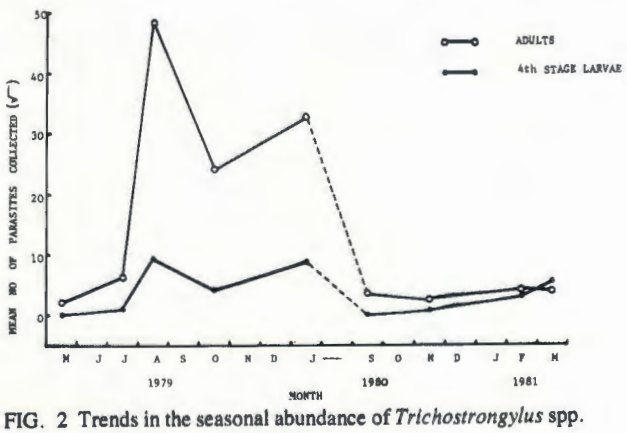

FIG. 2 Trends in the seasonal abundance of *Trichostrongylus* spp.

TABLE 1 Amended host-parasite list of helminths of the grey duiker

Helminth	Reference
Cotylophoron cotylophorum (Fischoeder, 1901)	Ortlepp, 1961
Paramphistomum sp.	This paper
Avitellina centripunctata (Rivolta, 1874)	Baer, 1925; 1926; Ortlepp, 1961
Coenurus sp.	Gough, 1910
Cysticercus dromedarii	Coll, 1949
Cysticercus tenuicollis	Gough, 1908; Mönnig, 1928; Ortlepp, 1961
Cysticercus sp.	Ortlepp, 1961
Larval form of *Echinococcus granulosus*	Ricci, 1939, cited by Round, 1968
Moniezia expansa (Rudolphi, 1810)	Baer, 1925; 1926; Mönnig, 1928
Stilesia hepatica Wolffhugel, 1903	Ortlepp, 1961
Larval form of *Taenia hyaenae*	Graber, 1978
Cooperia fuelleborni Hung, 1926	Diaouré, 1964
Cooperia acutispiculum Boomker, 1982	Boomker, 1982
Cooperia hungi Mönnig, 1931	This paper
Cooperia neitzi Mönnig, 1932	This paper
Cooper pectinata Ransom, 1907	This paper
Gongylonema pulchrum Molin, 1857	Fain, 1955
Haemonchus contortus (Rudolphi, 1803)	Ortlepp, 1961
Haemonchus vegliai Le Roux, 1929	Ortlepp, 1961
Impalaia nudicollis Mönnig, 1931[1]	Mönnig, 1933
Impalaia tuberculata Mönnig, 1923	This paper
Nematodirus sp.	This paper
Oesophagostomum columbianum Curtice, 1890[1]	Mönnig, 1933
Onchocerca sp.	Le Roux, 1947
Ostertagia sissokoi Diaouré, 1964	Diaouré, 1964
Setaria caelum (Von Linstow, 1904)	Ortlepp, 1961
Setaria hornbyi Boulenger, 1921	Mönnig, 1924; Thwaite, 1927
Setaria saegeri (Le Van Hoa, 1962)	Le Van Hoa, 1962, cited by Round, 1968
Skrjabinodera kuelzii (Rodenwaldt, 1910)	Kreiss, 1938
Subulura distans (Rudolphi, 1809)	Vuylsteke, 1956, cited by Round, 1968
Trichostrongylus axei (Cobbold, 1879)	This paper
Trichostrongylus colubriformis (Giles, 1892)	This paper
Trichostrongylus falculatus (Ransom, 1911)	This paper
Trichostrongylus instabilis Mönnig, 1933	This paper
Trichuris ovis (Abildgaard, 1795)	Vuylsteke, 1956, cited by Round, 1968
Trichuris sp.	Allen & Loveridge, 1933, cited by Round, 1968

[1] Adults of these nematodes were recovered from *S. grimmia* after artificial infestation

TABLE 2 The helminth parasites recovered from the grey duiker from Riekert's Laager

Duiker No.	Sex	Date	Numbers of helminths recovered																										
			Trematodes	Nematodes																							Cestodes			
			Paramphistomum sp.	*Haemonchus*				*Trichostrongylus*						*Cooperia*					*Impalaia tuberculata*		*Nematodirus* sp.		*Oesophagostomum* sp.	*Longistrongylus* sp.	*Setaria* sp.	*Skrjabinodera* sp.	*Trichuris* sp.	*Moniezia expansa*	*Avitellina* sp.	*Taenia* sp. larval form	Total
				L_4	Females	*H. contortus* ♂	*H. vegliai* ♂	L_4	Females	*T. axei* ♂	*T. colubriformis* ♂	*T. falculatus* ♂	*T. instabilis* ♂	L_4	Females	*C. hungi* ♂	*C. neitzi* ♂	*C. pectinata* ♂	L_4	A	L_4	♀	L_4	L_4	A	♀	♀				
1	♀♂	May,, '79	*	249	1	10	0	0	2	1	1	0	0	90	0	0	0	0	0	20	0	0	0	0	9	0	10	19	9	0	421
2	♀♂	,,	*	0	0	0	3	0	2	5	0	0	0	14	107	6	70	0	0	181	0	0	0	0	0	0	0	0	2	0	390
3	♀♂	July,, '79	*	0	0	0	2	0	24	6	0	5	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	41
4	♀♂	,,	*	19	0	0	0	2	25	20	1	0	0	0	0	0	0	0	0	0	24	0	1	0	0	0	0	0	0	0	92
5	♀♂	Aug.,, '79	*	90	0	0	0	195	2 455	2 131	0	0	0	107	124	0	0	0	70	751	0	0	0	0	0	0	0	0	0	0	5 923
6	♀♂	,,	*	2	0	0	0	0	30	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63
7	♀♂	Oct.,, '79	*	96	0	0	0	43	690	420	0	11	0	0	10	10	0	0	31	130	0	0	0	0	3	1	0	0	0	0	1 445
8	♀♂	,,	*	0	10	0	10	1	56	26	0	0	0	0	10	0	0	0	0	40	0	0	0	0	1	0	0	0	1	0	155
9	♀♂	Jan., '80	52	10	0	0	0	88	748	333	0	0	0	0	0	0	0	0	10	30	0	0	0	0	2	0	10	0	0	0	1 283
14	♀♂	Sept., '80	156	10	1	1	0	0	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	4	201
15	♀♂	Nov.,, '80	220	91	11	1	0	0	0	0	0	0	0	0	0	0	0	0	3	190	0	0	0	1	1	0	0	0	0	0	518
16	♀♂	,,	44	19	52	1	0	1	12	1	0	0	0	0	210	0	0	140	0	11	0	0	0	0	1	0	0	0	0	0	492
18	♂	Febr.,, '81	84	0	0	0	0	7	13	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112
19	♂	,,	60	2	11	0	0	11	7	3	0	0	0	0	0	0	0	0	22	121	0	0	0	0	0	0	0	0	0	0	237
20	♂	March '81	2	25	1	0	1	43	12	1	0	0	1	91	519	506	0	0	485	734	0	0	0	0	1	0	0	0	0	0	2 422
21	♂	,,	0	0	0	0	0	10	13	10	0	0	0	20	15	8	0	0	36	12	0	0	0	0	0	0	0	1	0	0	125

* = Rumen and caecum not available for parasitological studies
A = Adults
L_4 = 4th stage larvae
♀ = Female
♂ = Male

TABLE 3 The total and mean helminth burdens of the grey duiker from Riekert's Laager

	Paramphistomum sp.	*Haemonchus* spp.		*Trichostrongylus* spp.		*Cooperia* spp.		*I. tuberculata*		Miscellaneous nematodes		Cestodes	
		L_4	Adult	L_4	Adult	L_4	Adult	L_4	Adult	L_4	Adult	Larval forms	Adult
Total	618	613	106	401	7 127	322	1 735	657	2 220	26	48	4	32
Mean	77,2	38,3	6,6	25,1	445,4	20,1	108,4	41,1	138,7	1,6	3	0,25	2
No. of animals positive	7/8	11/16	9/16	10/16	15/16	5/16	7/16	7/16	11/16	2/16	9/16	1/16	4/16

L_4 = Fourth stage larvae

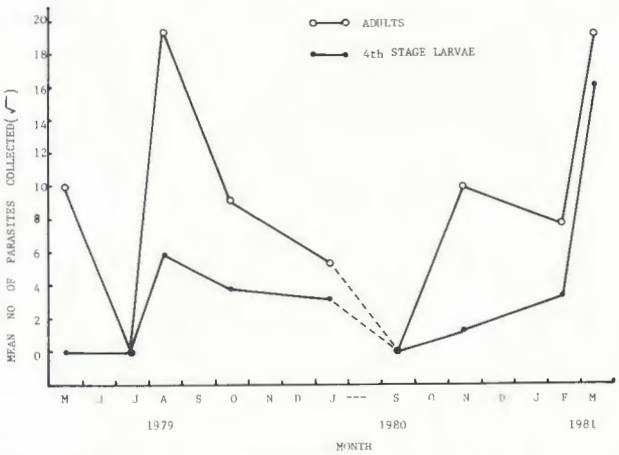

FIG. 3 Trends in the seasonal abundance of *Impalaia tuberculata*

Nematodirus sp., and *Paramphistomum* sp. One 4th stage larva of a *Longistrongylus* sp. was also recovered, but it has not been included in the list.

Ten nematodes could be identified specifically, and 6 generically only, but of the 3 cestodes and 1 trematode recovered only 1 was identified specifically.

Numerous 4th stage larvae of *Haemonchus* spp. (249) were present during May 1979 (Fig. 1). The majority of these were probably seasonally arrested larvae, overwintering in the duikers. From August to October 1979, the number of 4th stage larvae remained constant, whereas the adult worm burdens rose. The rise in 4th stage larvae during November 1980 probably resulted from the increased number of infective larvae on the vegetation produced by the adult worms that had developed from the arrested larvae acquired during the preceding autumn.

Nematodes of the genus *Trichostrongylus* were recovered from 15 out of the 16 antelope examined. Peak numbers of adult worms occurred in August 1979 and January 1980, while fairly high numbers were also recorded in October 1979 (Fig. 2). These peaks are mainly due to the presence of large numbers of *T. axei*. Burdens of 4th stage larvae also increased during the same months, but only once were more than 100 larvae recovered from a single animal.

Only 2 animals harboured small numbers *T. falculatus,* but as their 4th stage larvae are indistinguishable from those of the other *Trichostrongylus* spp. no deductions could be made from these data.

None of the grey duikers that harboured more than 300 adult *T. axei* had any adult *Haemonchus* spp., although 4th stage larvae of the latter were present. For example, Duiker 7, which was culled in October 1979, had 420 adult *T. axei* males and 96 4th stage *Haemonchus* larvae, but no adult *Haemonchus* were present. A similar pattern was seen in Duikers 5 and 9. Duiker 8, which was also shot in October 1979, harboured 82 adult *T. axei* and no 4th stage *Haemonchus* larvae, but 20 adults were present. The same was seen in Duiker 16.

Moderate numbers of adult *I. tuberculata* were recovered from individual animals culled during May, August and October 1979, as well as in November 1980 and March 1981. Peak adult burdens were seen during August 1979 and March 1981. Apart from May 1979, when no 4th stage larvae were found, and November 1980, when only 3 were recovered, the larval pattern followed that of the adults (Fig. 3).

Only 8 out of the 16 duikers were infested with *Cooperia* spp. One duiker had both *C. hungi* and *C. neitzi,* and a further 3 duikers *C. hungi,* but only 1 had *C. pectinata*. The other 3 animals had either 4th stage larvae or female *Cooperia* spp. only. In May and October 1979, and in March 1981, the duikers shot harboured *Cooperia* spp. and other than this no pattern of infestation could be established.

Adult females of *Nematodirus* sp. were found in Duiker 3 only, while 4th stage larvae of a *Nematodirus* sp. and an *Oesophagostomum* sp. occurred in Duiker 4. A single 4th stage *Longistrongylus* larva was present in Duiker 15, and a single *Skrjabinodera* female was recovered from the subcutis of Duiker 7. Two duikers harboured *Trichuris* sp. females, but adult *Setaria* sp. occurred in 9 out of the 16 duikers.

With the exception of Duiker 1, which harboured 19 adult *Moniezia expansa,* small numbers of cestodes were found in only a few of the animals examined.

Adult *Paramphistomum* sp. were present in the rumen of 7 out of the 8 animals.

Arthropods

Five ticks were identified specifically and 1 to generic level, as well as 3 species of lice and 1 species of hippoboscid fly. Their numbers are listed in Table 4, while trends in the seasonal variation of the immature stages of *Amblyomma hebraeum* and *Rhipicephalus appendiculatus* are illustrated in Fig. 4 and 5, respectively, and that of *Lipoptena paradoxa* in Fig. 6.

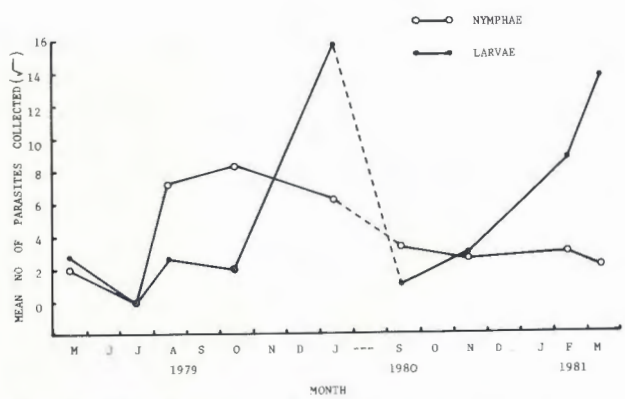

FIG. 4 Trends in the seasonal abundance of the immature stages of *Amblyomma hebraeum*.

Amblyomma hebraeum, the tick most frequently encountered, represented 55,9 % of the total number of ticks recovered. Adult ticks were recovered during May and October 1979 only and constituted 0,8 % of the total number of *A. hebraeum* collected. The immature stages were recovered mostly during the summer months, with peak larval burdens occurring in January 1980 and February and March 1981 (Fig. 4). Peak nymphal burdens were observed in August and October 1979.

R. appendiculatus represented 36,6 % of the total number of ticks collected. Adult ticks were recovered during July, August and October 1979, January 1980 and February and March 1981, but represented only 4,25 % of the total number of *R. appendiculatus* collected. Peak numbers of larvae were recorded in May 1979 and February 1981, while peak numbers of nymphae occurred during May 1979 and September 1980 (Fig. 5).

TABLE 4 The arthropod parasites recovered from the grey duiker from Riekert's Laager

			Numbers of arthropods recovered																			
			Ticks												Lice						Flies	
			Rhipicephalus appendiculatus			*Rhipicephalus evertsi evertsi*			*Boophilus decoloratus*			*Amblyomma hebraeum*			*Damalinia lerouxi*		*Linognathus breviceps*		*Linognathus zumpti zumpti*		*Lipoptena paradoxa*	
No	Sex	Date	L	N	A	L	N	A	L	N	A	L	N	A	N	A	N	A	N	A	A	Total
1	♀	May '79	16	7	0	0	2	2	1	0	0	1	0	0	8	6	0	8	0	0	4	55
2	♂	"	82	204	0	6	3	0	0	0	0	15	8	1	210	41	5	0	0	0	42	617
3	♀	July '79	6	18	1	3	2	0	0	0	0	0	0	0	2	2	5	3	0	0	5	47
4	♀	"	1	6	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	15	24
5	♂	Aug '79	7	40	0	0	0	0	0	0	0	1	98	0	1	2	18	21	1	0	55	244
6	♀	"	0	4	1	0	0	0	0	0	0	14	3	0	0	5	1	6	1	0	0	35
7*	♀	Oct '79	3	10	0	0	0	1	0	0	2	3	110	1	0	0	367	126	0	0	5	630
8	♂	"	4	7	22	0	2	2	1	0	3	1	29	7	0	0	111	70	0	0	0	259
9	♀	Jan '80	1	0	1	16	8	0	4	0	2	245	39	0	0	0	0	0	484	1 012	0	1 812
14	♂	Sept '80	1	59	0	0	0	0	0	1	0	1	11	0	1	2	0	2	0	0	27	105
15	♀	Nov '80	3	0	0	0	0	0	0	2	0	18	13	0	0	0	0	0	0	0	4	40
16	♀	"	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	27	31
18	♂	Feb '81	106	1	2	0	0	0	3	6	4	50	17	0	1	5	2	0	0	0	10	207
19	♂	"	34	0	0	0	0	0	0	1	0	102	0	0	0	1	1	1	0	0	0	140
20	♂	Mar '81	37	0	4	7	0	1	0	5	0	81	1	0	0	0	2	1	0	0	57	196
21	♂	"	76	7	2	51	1	0	12	2	0	304	8	0	0	6	0	0	0	0	26	495

A = Adults
N = Nymphs
L = Larvae
♂ = Males
♀ = Females
* = One *Boophilus microplus* female and 1 *Haemaphysalis* sp. L also recovered from Duiker 7

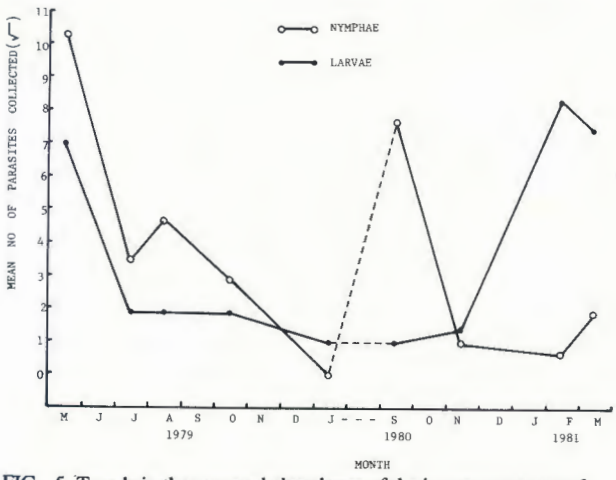

FIG. 5 Trends in the seasonal abundance of the immature stages of *Rhipicephalus appendiculatus*

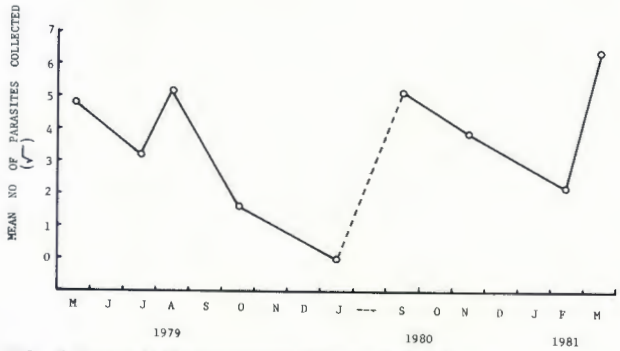

FIG. 6 Trends in the seasonal abundance of adult *Lipoptena paradoxa*

Few specimens of either *Rhipicephalus evertsi evertsi* or *Boophilus decoloratus* were collected, and no clear pattern in their seasonal prevalence was evident. A single female of *Boophilus microplus* was found and 1 *Haemaphysalis* sp. larva.

Linognathus zumpti zumpti was the most numerous louse, but 1 496 of the 1 498 specimens collected were recovered from Duiker 9, shot in January 1980. *Damalinia lerouxi* and *Linognathus breviceps* were recovered more consistently, but in smaller numbers.

Moderate numbers of the hippoboscid fly *L. paradoxa* were recovered from 12 out of the 16 animals examined. Apparently these flies are more abundant in autumn and spring, and their numbers decline during the hot summer months.

DISCUSSION

As this study was not conducted at monthly intervals over a period of a year, it cannot be regarded as a strictly seasonal study of the parasites of grey duikers. However, sufficient data were accumulated to show trends in the seasonal occurrence of some of these parasites. These trends resembled those observed in surveys of a similar nature conducted on a strictly seasonal basis by Horak (1980a; 1982) and Horak *et al.* (1982)

Helminths

Horak (1980 a) lists the various helminths that have been recovered from sheep, cattle, impala and blesbok in the Republic of South Africa as definitive, occasional or accidental parasites of their respective hosts. He suggests that definitive parasites are present in a large percentage of a host population, often occur in large numbers, and can reproduce and survive for long periods in these hosts. Occasional parasites are present in varying numbers in some of the hosts only. They may be capable of reproduction, but survive for only a limited period. Accidental parasites are present in small numbers in a low percentage of the hosts. They may not be able to develop into adults, and even if they do, they may not be able to reproduce. Their survival period in the host may also be short.

In assessing the status of the parasite it is therefore extremely important to determine the normal or mean parasite burdens as well as the species involved.

Horak (1981) states that, to determine host-specificity, large numbers of animals from various localities must be examined, and that both the immature and adult stages of the parasites must be recovered, counted and identified. His studies were limited to impala and blesbok, both of which are grazing animals. These usually harbour larger numbers of internal parasites than browsers as is shown by previous work on grazing antelope in the Transvaal (Young & Wagener, 1968; Horak, 1978 a, b; 1980 a).

Grey duikers are exclusively browsers, feeding on forbs at ground level and also on low shrubs. Browsers, because of their selective feeding habits, would not as a rule be subjected to the same levels of infestation as grazers, if one can assume that infective larvae are present in equal numbers on forbs and grass. Infective larvae that emerge from dung patches may, however, migrate onto forbs browsed by grey duikers, particularly when there is no grass, as is the case in heavily overgrazed areas. These forbs are often avoided by such grazers as sheep and cattle, but are consumed by duikers, resulting in high infestations. This appeared to be the case with Duikers 5, 7, 9 and 20, all of which harboured worm burdens in excess of the mean.

Horak (1980 a) states that accidental parasitism often occurs when different hosts are present in the same limited area, a situation which occurred on the farm where this study was conducted. Accidental parasitism occurred, firstly, because of the presence of other antelope on the farm and, secondly, because grey duikers are not strictly territorial and wander considerably. Their small size makes them difficult to confine and they go through conventional game fences with ease.

Riekert's Laager is close to a black homeland where large numbers of sheep and goats are kept, and some of the grey duikers had probably moved from this homeland to the farm before they were shot. This could explain the presence of nematodes, such as *T. colubriformis, Nematodirus* sp. and *Oesophagostumum* sp., all of which are parasites of sheep and goats and can be regarded as accidental parasites of the grey duiker.

The mean burdens of both larval and adult helminths of the grey duiker on Riekert's Laager over the entire survey period are listed in Table 3. These values are applicable only to duikers from the study area and can be expected to vary during abnormally dry or abnormally wet conditions, or when any form of anthelmintic is administered to any of the antelope present.

Four genera of nematodes occurred regularly in the animals, and because it is impossible to identify the 4th stage larvae of *Haemonchus* and *Trichostrongylus* specifically, trends in their seasonal variation are discussed generically. The 4th stage larvae of *I. tuberculata* have trifurcate tails and they are easy to identify. Trends in the seasonal variation of this nematode are illustrated in Fig. 3.

H. contortus would probably represent occasional parasitism, since this nematode is certainly one of the commonest parasites of both domestic and wild artiodactylids (Round, 1968; Gibbons, 1979). On the other hand *H. vegliai* is essentially a parasite of antelope and has not been reported from domestic ruminants. Its presence in grey duikers is therefore not unexpected (Round, 1968; Gibbons, 1979). Although the burdens seem low in duikers, the parasite should be regarded as a definitive parasite, as it is not usually present in large numbers (Boomker, unpublished data, 1981; Horak, personal communication, 1981). Trends in the seasonal variation of *Haemonchus* spp. resemble those of *H. contortus* in sheep (Viljoen, 1964; Reinecke, 1964) and impala and blesbok (Horak, 1978 a, b; 1980 a).

The similarities between *T. colubriformis* and *T. instabilis* have been discussed by Ransom (1911). Subsequently, Lane (1913) synonymized *T. instabilis* with *T. colubriformis*. Mönnig (1931, 1933), however, retained the name *T. instabilis* and in 1933 illustrated what he considered to be a normal spicule, which appears to be identical with those of *T. colubriformis,* as well as an extreme variation with a short hook and a markedly bent spicular shaft. Horak (1980 a) recovered a *Trichostrongylus* sp. from cattle and impala in the northern Transvaal that had spicules similar to the extreme variation of *T. instabilis* illustrated by Mönnig (1933). Horak (1980 a) artificially infested calves, sheep and goats with infective *Trichostrongylus* larvae obtained from faecal cultures of impala. He found that the shape of the spicules was retained in the males that developed and suggested that the worms represented a separate, but unnamed, species. In this paper the single worm with spicules that showed the extreme variation illustrated by Mönnig (1933) is referred to as *T. instabilis,* while those with the normal spicules are named *T. colubriformis*. The occurence of *T. instabilis* in duikers should be regarded as accidental, since a single male was found in 1 of the animals only.

T. colubriformis is a nematode that is found in a wide range of antelope (Round, 1968). Its occurrence in grey duikers also seems to be accidental, since only 2 adult worms were found. They were probably acquired from sheep or goats outside the study area.

T. axei has been recorded from sheep and cattle (Soulsby, 1969; Georgi & Theodorides, 1980), a wide variety of antelope (Round, 1968) and also perissodactylids and primates (Round, 1968; Soulsby, 1969; Georgi & Theodorides, 1980; Horak, personal communication, 1981). In view of its occurrence in 15 out of the 16 animals it should be regarded as a definitive parasite.

The presence of many *T. axei* in the grey duikers does not confirm the results of Horak (1980 a), who found no *T. axei* on the Transvaal highveld and few in the northern Transvaal. He stated that the Transvaal climate does not favour the survival of the free-living stages of the *Trichostrongylus* spp., with the possible exception of *T. falculatus*. Viljoen (1969) found that the free-living stages of *T. falculatus* could survive with rainfall as low as 25 mm per month, provided a good rainfall occurred the previous autumn and that the winter temperatures were low.

From the results it can be seen that none of the duikers that harboured more than 300 *T. axei* had any adult *Haemonchus* spp. Fourth stage larvae of the latter, however, were present. The findings of Reinecke (1974) and Reinecke, Snyman & Seaman (1979), that the presence of *T. axei* prevented *Haemonchus* larvae from reaching adulthood in sheep, seem to be applicable to grey duikers as well.

The presence of *T. falculatus* in duikers as well as impala (Horak, 1980 a) indicates that this nematode is more common in antelope than the literature would suggest (Round, 1968). It was also recovered from a steenbok from the study area (520 adults) and, because of its low incidence in duikers, it should be regarded as an accidental parasite, probably acquired from either steenbok or sheep outside the study area.

Both *C. hungi* and *C. neitzi* are parasites of a wide range of antelope (Round, 1968; Baker & Boomker, 1973; Horak, 1981 a), and could be regarded as definitive parasites of grey duikers. *C. pectinata* is mainly a cattle parasite, but it has adapted itself to a number of antelope (Round, 1968). As only 1 duiker harboured this parasite, it should be regarded as an accidental parasite.

I. tuberculata is one of the most prevalent parasites of game animals (Round, 1968; Boomker, 1977; Gibbons, Durette-Desset & Daynes, 1977; Horak, personal communication, 1981) and it is surprising that it has not yet been recorded from the grey duiker. Eleven out of 16 animals harboured this species, and it is therefore a definitive parasite of this antelope.

The results of this study suggest that *I. tuberculata* has a non-seasonal incidence and resemble those of Horak (1980 a) for adult *I. tuberculata* from blesbok shot in the eastern Transvaal. Our findings differ, however, from those of Horak (1980 a) for impala in the northern Transvaal, where he found the adult parasites to be more abundant in summer.

A feature of the trends in seasonal occurrence was the rise in numbers of the adults of *Trichostrongylus, Cooperia* and *Impalaia* and the 4th stage larvae of *Haemonchus* in Duiker 5, but not in Duiker 6, during August 1979. The adult worms could have resulted from hypobiotic 4th stage larvae acquired during the preceding autumn, but the presence of the 4th stage *Haemonchus* larvae cannot be explained in terms of their survival on the veld, as temperatures were low, frost occurred frequently and no rain was recorded during the preceding 3 months.

Longistrongylus sp. is strictly an accidental parasite of the grey duikers, since only 1 of the 16 animals yielded a single 4th stage larva. The same applies to *Oesophagostomum* sp. a single 4th stage larva of which was found in the wall of the colon of 1 animal only. Mönnig (1933) recorded *O. columbianum* from a grey duiker after artificial infestation, but under natural conditions it seems to be unsuitable as a host for both *Longistrongylus* sp. and *Oesophagostomum* sp.

The 20 female *Trichuris* sp. probably represent occasional parasitism acquired from sheep or goats from the neighbouring homelands. However, its occurrence in antelope is not rare (Round, 1968), and cross-infestation from other antelope cannot be excluded.

Round (1968) lists species of the genus *Setaria* as occurring in most antelope. Grey duikers are no exception, and 9 out of the 16 animals examined harboured these parasites.

Both *Moniezia expansa* and *Avitellina* sp. are common to domestic and wild artiodactylids (Round, 1968; Soulsby, 1969). In view of the fact that only 3 of the animals had from 1–9 *Avitellina* sp. and 1 had 19 *M. expansa,* their occurrence should be regarded as occasional.

The *Paramphistomum* infestation was probably acquired from either a marshy area outside the study area

or from the major watering points inside the farm. *Paramphistomum* spp. should be regarded as definitive parasites.

Arthropods

The numbers of ticks recovered in this study seem to be the highest yet recorded from grey duikers. A mean of 132 ticks (82 larvae, 46 nymphae, 4 adults) per animal was present, but a mean of 600 ticks (510 larvae, 87 nymphae, 3 adults) has been found on duikers from the Kruger National Park (Boomker, unpublished data, 1980). This indicates that grey duikers may act as hosts for the immature stages of a number of ticks, 4 of which are also commonly found on cattle. The duikers, however, seem unable to maintain the adult ticks in significant numbers. MacLeod (1970) and MacLeod *et al.* (1977) recorded a total of 15 ticks (all adult) from 6 duikers they examined, and Norval (1977) found a few *Rhipicephalus tricuspis* on duikers in Zimbabwe. These observations seem to corroborate those of Horak (1980 b) that the smaller antelope harbour few adult ticks. The size of the antelope host and the presence of adult ticks have also been commented on by MacLeod *et al.* (1977), who stated that the larger the host, the more adult ticks it seems likely to carry, and Knight & Rechav (1978) found large numbers of both adult and immature ticks on kudu.

As part of this study, a weekly dipping programme for the cattle in the study area was instituted from January 1980 onwards. This was done to determine whether eradication of ticks on cattle would result in lowered burdens on the duikers. No such correlation was found, and almost twice the number of ticks were recovered from the 8 duiker culled during the time the cattle were dipped (764 prior to and 1 354 during dipping). These figures are probably biased, because the first 8 duikers were culled in winter and spring when ticks were less abundant than during the summer months when the second group of duikers was shot. One must remember, however, that the duikers could have acquired the ticks outside the study area. The presence of other game species on the farm also have contributed to the burdens on the duikers. These findings have led to the opinion that game animals are much more important in the distribution of ticks, and possibly indirectly in the distribution of tick-borne diseases of domesticated animals, than is currently recognised.

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