

# PARASITES OF SOUTH AFRICAN WILDLIFE. I. HELMINTHS OF BUSHBUCK, *TRAGELAPHUS SCRIPTUS*, AND GREY DUIKER, *SYLVICAPRA GRIMMIA*, FROM THE WEZA STATE FOREST, NATAL

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## ABSTRACT

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Thirteen bushbuck, *Tragelaphus scriptus*, and 13 grey duikers, *Sylvicapra grimmia*, were culled in the Weza State Forest, Natal, from May 1983–May 1984. The maximum number of worms recovered from a single bushbuck was 393. Of the total number of worms recovered from all the bushbuck, *Paracooperia devossi* were the most numerous, followed by *Ostertagia harrisi*, a *Cooperia* sp. and *Haemonchus vegliai*. *P. devossi* and *O. harrisi* were more numerous during winter and the *Cooperia* sp. more numerous during summer.

Grey duiker harboured from 0–230 worms. The same *Cooperia* sp. as was recovered from the bushbuck and *Trichostrongylus axei* were the most numerous. The larvae of *Taenia hydatigena* were recovered from 5 duikers. The *Cooperia* sp. was more numerous during summer and *T. axei* during winter, the remaining worms showing no seasonal pattern of abundance.

Amended lists of the helminth parasites found in these antelope in the Republic of South Africa are provided.

## INTRODUCTION

Bushbuck, *Tragelaphus scriptus*, are medium-sized antelope which are widespread in Africa south of the Sahara, wherever their rather specialized habitat is found (Meester & Setzer, 1971; Smithers, 1983). They are nocturnal animals that prefer underbrush adjacent to a permanent water supply and are predominantly browsers, consuming the fruits, seeds, pods, flowers, leaves and shoots of a large variety of plants (Dorst & Dandelot, 1972; Hofmann, 1973). Bushbuck usually are solitary animals, although small groups comprising both sexes and various age categories may be encountered in very favourable habitats.

The internal parasites of bushbuck in the Republic of South Africa are listed by Round (1968), while Keep (1983), Boomker & Kingsley (1984), Boomker, Keep, Flamand & Horak (1984) and Boomker, Horak & De Vos (1986) added several helminths to this list. No other records could be found in the literature.

The habitats, food preferences and parasites of grey duiker, *Sylvicapra grimmia*, have been commented on by Boomker, Du Plessis & Boomker (1983).

A number of bushbuck and grey duiker were culled in the Weza State Forest, Natal, for purposes not related to parasitological studies. As part of the ongoing study of the helminth parasites of free-living artiodactylids in the various game reserves in South Africa, the opportunity was taken to collect the parasites of 13 of each of the antelope species during the later stages of the project. The helminths recovered from these animals and trends in their seasonal prevalence are discussed in this paper. Amended lists of the helminth parasites for both the antelope species are provided.

## MATERIALS AND METHODS

The animals were culled in the Weza State Forest (30° 35' S 29° 45' E; Altitude 900–2 200 m), comprising an area 21 700 ha in extent in the Alfred district, Natal. During the year May 1983–May 1984 the total rainfall

was 1 220 mm, most of which fell between November and March. The mean minimum and maximum temperatures varied from 6.5–18 °C in July (winter) to 16–25 °C in January (summer). Frosts were experienced at night in winter.

Three major vegetation types are recognized in the forest. These are mountain grassland (27%), indigenous montane forest (19%) and plantations of exotic trees (54%). The grassland consists of Nongoni veld, Dohne Sourveld and Highland Sourveld (Acocks, 1975). The plantations consist predominantly of *Pinus* spp., with small aggregations of *Acacia mearnsii*, *Acacia melanoxylon*, *Populus deltoides* and *Eucalyptus* spp.

In addition to bushbuck and grey duiker, small numbers of oribi, *Ourebia ourebi*, blue duiker, *Cephalophus monticola*, and vaal ribbok, *Pelea capreolus*, also occur. Mules and horses are kept as transport animals, and cattle, sheep, goats, pigs and dogs occasionally stray into the forest from the surrounding farms.

One bushbuck and 1 grey duiker were culled each month for 13 consecutive months from May 1983–May 1984. Their sexes depended on availability, and 6 adult male bushbuck, 5 adult females, 1 sub-adult male and 1 sub-adult female were collected. Eight adult male grey duiker, 3 adult females and 2 sub-adult females were culled.

The lungs, hearts and livers of the animals were processed for helminth recovery as described by Horak (1978), and the abomasa, the small and the large intestines as described by Reinecke (1973). 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. These aliquots were examined by means of a stereoscopic microscope.

The adult worms were identified under a standard microscope, using the descriptions of the authors listed in Tables 1 and 2. These tables also list the helminths recovered to date from bushbuck and grey duikers. In cases where more than 1 species of a genus was present, the males, but not the females, were identified specifically. Fourth stage larvae were identified to generic level only.

## RESULTS

### *Bushbuck* (Table 3)

Eight nematode genera and species were recovered and in many instances only female worms were present.

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TABLE 1 Amended list of the helminth parasites of bushbuck in the Republic of South Africa with reference to the first record and the authors used to assist with the identification

Parasite	First Record	Identification
Trematodes		
No trematodes appear to have been recorded		
Cestodes		
<i>Cysticercus</i> spp. (sic)	Le Roux, 1930 a	*
<i>Taenia</i> spp. larvae	Boomker <i>et al.</i> , 1984	Verster, 1969
Nematodes		
<i>Ashworthius pattoni</i> Le Roux, 1930 b	Le Roux, 1930 b	*
<i>Cooperia neitzi</i> Mönning, 1932	Boomker <i>et al.</i> , 1986	Gibbons, 1981
<i>Cooperia</i> sp. Ransom, 1907	Boomker <i>et al.</i> , 1986	Gibbons, 1981
<i>Cordophilus sagittus</i> (Von Linstow, 1907)	Mönning, 1926	Mönning, 1926
<i>Dictyocaulus viviparus</i> (Bloch, 1782)	Boomker <i>et al.</i> , 1986	Yorke & Maplestone, 1926
<i>Gaigeria</i> sp. Railliet & Henri, 1910	Boomker <i>et al.</i> , 1986	Yorke & Maplestone, 1926
<i>Gongylonema</i> spp. Molin, 1857	Keep, 1983	Yorke & Maplestone, 1926
<i>Haemonchus bedfordi</i> Le Roux, 1929	Le Roux, 1930 a	*
<i>Haemonchus contortus</i> Cobb, 1898	Veglia, 1919	*
<i>Haemonchus vegliai</i> Le Roux, 1929	Ortlepp, 1961	Gibbons, 1979
<i>Impalaia</i> spp. Mönning, 1923	Keep, 1983	*
<i>Microfilaria</i> spp. (sic) Neitz, 1931	Neitz, 1931	*
<i>Oesophagostomum columbianum</i> Curtice, 1890	Mönning, 1928	*
<i>Oesophagostomum</i> spp. Molin, 1861	This paper	Yorke & Maplestone, 1926
<i>Ostertagia harrisi</i> Le Roux, 1930 b	Le Roux, 1930 b	Le Roux, 1930 b
<i>Paracooperia devossi</i> Boomker & Kingsley, 1984	Boomker & Kingsley, 1984	Boomker & Kingsley, 1984
<i>Pneumostrongylus calcaratus</i> Mönning, 1932	Boomker <i>et al.</i> , 1986	Mönning, 1933
<i>Setaria africana</i> (Yeh, 1959)	Ortlepp, 1961	Yeh, 1959
<i>Setaria labiatopapillosa</i> (Perroncito, 1882)	Veglia, 1919	*
<i>Setaria yorkei</i> Thwaite, 1927	Ortlepp, 1961	*
<i>Setaria</i> sp. Viborg, 1795	Boomker <i>et al.</i> , 1986	Yeh, 1959
<i>Trichostrongylus falculatus</i> Ransom, 1911	Boomker <i>et al.</i> , 1986	Ransom, 1911
<i>Trichostrongylus instabilis</i> (Looss, 1905)	Boomker <i>et al.</i> , 1986	Mönning, 1933
<i>Trichostrongylus</i> spp. (Looss, 1905)	This paper	Ransom, 1911

\* = After Round (1968)

The most prevalent worm was *Ostertagia harrisi*, which occurred in 12 animals, followed by *Paracooperia devossi* (11 animals) and *Haemonchus vegliai* (4 animals). The smallest burden of only 2 nematodes occurred in a female culled in May 1983, and the largest burden of 393 worms in a male culled in August 1983. No cestodes or trematodes were recovered.

The most abundant parasite was *P. devossi*, followed by *O. harrisi*, a *Cooperia* sp. that is closely related to *Cooperia rotundispiculum* but not identical with it, and *H. vegliai*.

The 2 animals culled during July and August 1983 harboured more than 380 worms each, and their burdens consisted mainly of *O. harrisi* and *P. devossi*, which were present in about equal numbers. The 3 animals culled during November and December 1983 and January 1984 had burdens of between 102 and 303 worms. These were chiefly the *Cooperia* sp., with small numbers of *O. harrisi* and *P. devossi* also being present. The 2 bushbuck shot during April and May 1984 had 104 and 231 worms, respectively, of which *P. devossi* and *H. vegliai* were the most abundant.

*Grey duiker* (Table 4)

Five nematodes, 1 cestode and 1 trematode were recovered from these animals. The most prevalent was a *Cooperia* sp. identical with that recovered from the bushbuck, and it was present in 9 animals. The next most prevalent worm was *Setaria caelum* (8 animals), followed by *Trichostrongylus axei* (6 animals) and the larvae of *Taenia hydatigena* (5 animals).

The most abundant parasite was the *Cooperia* sp., followed by *T. axei*, *Ostertagia* spp. females, *S. caelum* and a *Trichuris* sp., of which only females were recovered. A female duiker culled during May 1983 had no worms, and a male culled in February 1984 harboured only 1 *T. hydatigena* larva. One animal was infested with 3 paramphistomes. The largest total burden of 230 worms was recovered from a male shot during May 1984.

The grey duikers shot during November 1983 and May 1984 each harboured more than 100 worms, the remaining animals having fewer than 90. The burden of the animal shot in November consisted mostly of the *Cooperia* sp., while *T. axei* was the dominant worm in the animal culled during May 1984.

DISCUSSION

*Bushbuck*

The *Cooperia* sp. recovered from these animals is closely related to *C. rotundispiculum*. This nematode has shorter spicules and 18–20 cuticular ridges as opposed to the longer spicules and 14 cuticular ridges of *C. rotundispiculum* (Gibbons, Lynda M., 1983, personal communication). The *Cooperia* sp. from red duiker, *Cephalophus natalensis*, identified by Boomker *et al.* (1984) as *C. rotundispiculum*, is in fact the same species as the present one. It was named *C. rotundispiculum* at the time, since we were of the opinion that it was a host variation of *C. rotundispiculum*, but the regularity with which it has since been recovered from a variety of antelope from all over the country (Boomker *et al.*, 1986) leads us to believe that this is a new species.

The number of helminth species and the size of the worm burdens of bushbuck from Charter's Creek were smaller than those of the same antelope from Weza forest (Boomker *et al.*, 1984). In addition to the worms recovered from bushbuck at Charter's Creek, the bushbuck from Weza forest harboured *H. vegliai*, a *Cooperia* sp., *Trichostrongylus* spp. and *Oesophagostomum* females. Bushbuck in the Kruger National Park (KNP) harboured all of the worm species recovered from the antelope at Charter's Creek and Weza forest, as well as *Trichostrongylus falculatus*, *Trichostrongylus instabilis*, *Cooperia neitzi*, a *Gaigeria* sp., *Dictyocaulus viviparus*, *Pneumostrongylus calcaratus* and *Cordophilus sagittus* (Boomker *et al.*, 1986). A possible explanation for these differences is that because few other antelope species

TABLE 2 Amended list of the parasites of grey duiker in the Republic of South Africa with reference to the first record and the authors used to assist with the identification

Parasite	First Record	Identification
Trematodes		
<i>Paramphistomum</i> spp. (Fishoeder, 1901)	Boomker <i>et al.</i> , 1983	Eduardo, 1982
Cestodes		
<i>Avitellina centripunctata</i> Gough, 1911	Baer, 1925	Wardle & McLeod, 1952
<i>Coenuris</i> sp. ( <i>sic</i> )	Gough, 1910	*
<i>Cysticercus</i> sp. ( <i>sic</i> )	Ortlepp, 1961	*
<i>Moniezia expansa</i> Blanchard, 1891	Baer, 1925	Wardle & McLeod, 1952
<i>Stilesia hepatica</i> Wolffhugel, 1903	Ortlepp, 1961	Wardle & McLeod, 1952
<i>Taenia hydatigena</i> larvae	This paper	Verster, 1969
<i>Taenia</i> spp. larvae	Boomker <i>et al.</i> , 1986	Verster, 1969
<i>Thysaniezia</i> Skrjabin, 1926	Boomker, Horak & MacIvor, unpubl.	Skrjabin & Spasski, 1963
Nematodes		
<i>Cooperia acutispiculum</i> Boomker, 1982	Boomker, 1982	Boomker, 1982
<i>Cooperia fuelleborni</i> Hung, 1926	Keep, 1983	**
<i>Cooperia hungi</i> Mönnig, 1931	Boomker <i>et al.</i> , 1983	Gibbons, 1981
<i>Cooperia neitzi</i> Mönnig, 1932	Boomker <i>et al.</i> , 1983	Gibbons, 1981
<i>Cooperia pectinata</i> Ransom, 1907	Boomker <i>et al.</i> , 1983	Gibbons, 1981
<i>Cooperia</i> sp. Ransom, 1907	Boomker <i>et al.</i> , 1986	Gibbons, 1981
<i>Cooperia</i> sp. Ransom, 1907	Keep, 1983	**
<i>Haemonchus bedfordi</i> Le Roux, 1929	Keep, 1983	**
<i>Haemonchus contortus</i> Cobb, 1898	Boomker <i>et al.</i> , 1983	Gibbons, 1979
<i>Haemonchus vegliai</i> Le Roux, 1929	Ortlepp, 1961	Gibbons, 1979
<i>Impalaia nudicollis</i> Mönnig, 1931 #	Mönnig, 1933	*
<i>Impalaia tuberculata</i> Mönnig, 1923	Boomker <i>et al.</i> , 1983	Boomker, 1977
<i>Longistrongylus sabie</i> (Mönnig, 1932)	Boomker, Horak & MacIvor, unpubl.	Gibbons, 1977
<i>Longistrongylus schrenki</i> Ortlepp, 1939	Keep, 1983	Gibbons, 1977
<i>Nematodirus abnormalis</i> May, 1920	Boomker, Horak & MacIvor, unpubl.	Becklund & Walker, 1967
<i>Nematodirus spathiger</i> (Railliet, 1886)	Boomker, Horak & MacIvor, unpubl.	Becklund & Walker, 1967
<i>Nematodirus</i> sp. Ransom, 1907	Boomker <i>et al.</i> , 1983	Ransom, 1911
<i>Oesophagostomum columbianum</i> Curdice, 1890 #	Mönnig, 1933	*
<i>Oesophagostomum</i> sp. larvae	Boomker <i>et al.</i> , 1983	
<i>Ostertagia circumcincta</i> Stadelmann, 1894	Boomker, Horak & MacIvor, unpubl.	Ransom, 1911
<i>Ostertagia</i> sp. Ransom, 1907	This paper	Le Roux, 1930 b
<i>Setaria caelum</i> (Von Linstow, 1904)	Ortlepp, 1961	Yeh, 1959
<i>Setaria hornbyi</i> Boulenger, 1921	Mönnig, 1924	*
<i>Setaria scalprum</i> (Von Linstow, 1908)	Boomker, Horak & MacIvor, unpubl.	Yeh, 1959
<i>Skrjabinodera kuelzii</i> (Rodenwaldt, 1910)	Boomker <i>et al.</i> , 1983	Kreiss, 1938
<i>Trichostrongylus axei</i> Looss, 1905	Boomker <i>et al.</i> , 1983	Ransom, 1911
<i>Trichostrongylus colubriformis</i> (Looss, 1905)	Boomker <i>et al.</i> , 1983	Ransom, 1911
<i>Trichostrongylus falcuatus</i> Ransom, 1911	Boomker <i>et al.</i> , 1983	Ransom, 1911
<i>Trichostrongylus instabilis</i> (Looss, 1905)	Boomker <i>et al.</i> , 1983	Mönnig, 1933
<i>Trichostrongylus piersi</i> Le Roux, 1932	Boomker, Horak & MacIvor, unpubl.	Le Roux, 1932
<i>Trichuris</i> sp. Roederer, 1761	This paper	Yorke & Maplestone, 1926

\* = After Round, 1968

\*\* = After Keep, 1983

# = Adults of these nematodes were recovered from sheep after artificial infestation with larvae obtained from the faeces of *S. grimmia*

TABLE 3 Helminths recovered from bushbuck in the Weza State Forest

Helminth species	Total number of worms recovered			Percentage animals infested
	4th stage	Adult	Total	
<i>Cooperia</i> sp.	0	220	220	15
<i>Gongylonema</i> sp.	0	8	8	15
<i>Haemonchus vegliai</i>	0	200	200	30
<i>Oesophagostomum</i> sp.	0	10	10	7
<i>Ostertagia harrisi</i>	2	693	695	92
<i>Paracooperia devossi</i>	0	722	722	84
<i>Setaria africana</i>	0	5	5	23
<i>Trichostrongylus</i> spp.	0	30	30	15

TABLE 4 Helminths recovered from grey duikers in the Weza State Forest

Helminth species	Total number of worms recovered			Percentage animals infested
	Larvae	Adult	Total	
<i>Cooperia</i> sp.	0	460	460	69
<i>Ostertagia</i> sp.	0	23	23	15
<i>Setaria caelum</i>	0	22	22	61
<i>Trichostrongylus axei</i>	0	253	253	46
<i>Trichuris</i> sp.	0	20	20	15
<i>Taenia hydatigena</i>	5	0	5	38
Paramphistomes	0	3	3	8

occur at Charter's Creek, the bushbuck there were exposed to cross-infestation to a much lesser extent than the ones in the Weza forest, where domestic ruminants also occasionally occur. The same applies when the helminths recovered from the Weza forest bushbuck are compared with those from the KNP, where numerous antelope species abound.

From the available data it appears that adult *O. harrisi* occurs in peak numbers during winter and in lesser numbers during summer. This is similar to the epidemiology of *Ostertagia circumcincta* in sheep in the summer rainfall areas (Reinecke, 1983). *P. devossi* shows a similar seasonal pattern. The *Cooperia* sp. occurred in larger numbers during summer and was not recovered during the cooler months of the year. It follows the seasonal pattern of *Cooperia* spp. of cattle in Natal (Hobbs, 1961). Unlike *Haemonchus contortus* in sheep in the summer rainfall regions, where adult worms are more prevalent during summer (Reinecke, 1983), adult *H. vegliai* occurred in peak numbers in May. In this respect *H. vegliai* behaves like *H. contortus* (syn. *Haemonchus placei*) in cattle in the summer rainfall areas, the latter being present at any time from August–April, provided that the rainfall is sufficient to allow the infective stages to escape from the dung (Reinecke, 1983).

*Grey duiker*

The worm burdens are smaller and fewer helminth

species were present in the duiker from Weza forest than in the duikers from the central Transvaal and the KNP (Boomker *et al.*, 1983; 1986). In both the latter localities the chances for cross-infestation from other herbivores is greater than in the Weza forest.

The only worms that showed seasonal trends of abundance were the *Cooperia* sp. and *T. axei*. The *Cooperia* sp. occurred in peak numbers in the animal shot in November, a similar observation made for this parasite in bushbuck from the same locality. Peak numbers of *T. axei* occurred during May. This corresponds with the trends in the seasonal prevalence of the same species observed in grey duiker from the central Transvaal and in domestic ruminants (Boomker *et al.*, 1983; Reinecke, 1983).

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## REFERENCES

- ACOCKS, J. P. H., 1975. Veld types of South Africa. *Memoirs of the Botanical Survey of South Africa*, No. 40, 128 pp.
- BAER, J. G., 1925. Contributions to the helminth fauna of South Africa. Thesis. Pretoria: Government Printing and Stationery Office.
- BECKLUND, W. W. & WALKER, MARTHA L., 1967. *Nematodirus* of domestic sheep, *Ovis aries* in the United States, with a key to the species. *Journal of Parasitology*, 53, 777-781.
- BOOMKER, J., 1977. A revision of the genus *Impalala* Mönnig, 1924. *Onderstepoort Journal of Veterinary Research*, 44, 131-138.
- BOOMKER, J., 1982. *Cooperia acutispiculum* n. sp. (Nematoda: Trichostrongylidae) from the kudu, *Tragelaphus strepsiceros* (Pallas, 1766). *Onderstepoort Journal of Veterinary Research*, 49, 95-97.
- BOOMKER, J., DU PLESSIS, W. H. & BOOMKER, ELIZABETH A., 1983. Some helminth and arthropod parasites from the grey duiker, *Sylvicapra grimmia*. *Onderstepoort Journal of Veterinary Research*, 50, 233-241.
- BOOMKER, J. & KINGSLEY, SHIRLEY A., 1984. *Paracooperia devossi* n. sp. (Nematoda: Trichostrongylidae) from the bushbuck, *Tragelaphus scriptus* (Pallas, 1766). *Onderstepoort Journal of Veterinary Research*, 51, 21-24.
- BOOMKER, J., KEEP, M. E., FLAMAND, J. R. & HORAK, I. G., 1984. The helminths of various antelope species from Natal. *Onderstepoort Journal of Veterinary Research*, 51, 253-256.
- BOOMKER, J., HORAK, I. G. & DE VOS, V., 1986. The helminth parasites of various artiodactylids from some South African nature reserves. *Onderstepoort Journal of Veterinary Research*, 53, 93-102.
- DORST, J. & DANDELON, P., 1972. A field guide to the larger mammals of Africa. London & Glasgow: Collins.
- EDUARDO, S. L., 1982. The taxonomy of the family Paramphistomidae Fischeoeder, 1901 with special reference to the morphology of species occurring in ruminants. I. General considerations. *Systematic Parasitology*, 4, 7-57.
- GIBBONS, LYNDA M., 1977. Revision of the genera *Longistrongylus* Le Roux, 1931. *Kobusinema* Ortlepp, 1963 and *Bigalikenema* Ortlepp, 1963 (Nematoda: Trichostrongylidae). *Journal of Helminthology*, 51, 41-62.
- GIBBONS, LYNDA M., 1979. Revision of the genus *Haemonchus* Cobb, 1898 (Nematoda: Trichostrongylidae). *Systematic Parasitology*, 1, 3-24.
- GIBBONS, LYNDA M., 1981. Revision of the African species of the genus *Cooperia* Ransom, 1907 (Nematoda: Trichostrongylidae). *Systematic Parasitology*, 2, 219-252.
- GOUGH, H. L., 1910. Note on a coenurus of the duikerbok. *Transactions of the Royal Society of South Africa*, 1, 343-345.
- HOBBS, W. B., 1961. Helminth research in South Africa. I. Seasonal incidence of nematode parasites in cattle in the Natal coastal area. *Journal of the South African Veterinary Medical Association*, 32, 151-155.
- HOFMANN, R. R., 1973. The ruminant stomach. East African Monographs in Biology. East African Literature Bureau.
- HORAK, I. G., 1978. Parasites of domestic and wild animals in South Africa. IX. Helminths in blesbok. *Onderstepoort Journal of Veterinary Research*, 45, 55-58.
- KEEP, M. E., 1983. The helminth parasites recorded from larger indigenous animal species in Natal. Natal Parks Board Internal Report. Mimeographed; pp 1-24.
- KREISS, H. A., 1938. Beiträge zur Kenntnis parasitischer Nematoden. VIII. Neue parasitische Nematoden aus dem Naturhistorischen Museum, Basel. *Zentralblatt für Bakteriologie und Infektionskrankheiten*, 142, 329-352.
- LE ROUX, P. L., 1930 a. Helminthiasis of domestic stock in the Union of South Africa. *Journal of the South African Veterinary Medical Association*, 1, 43-65.
- LE ROUX, P. L., 1930 b. On two new helminths from the abomasum of the bushbuck in Zululand, Natal. *16th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa*, pp 233-241.
- LE ROUX, P. L., 1932. On *Trichostrongylus pietersi*, sp. n. a parasite of sheep and goats. *Annals and Magazine of Natural History*, Series 10, 10, 502-504.
- MEESTER, J. A. J. & SETZER, H. W., 1971. The mammals of Africa: an identification manual. Washington: The Smithsonian Institution.
- MÖNNIG, H. O., 1924. South African parasitic nematodes. *9th and 10th Reports of the Director of Veterinary Education and Research, Department of Agriculture, Union of South Africa*, pp 435-478.
- MÖNNIG, H. O., 1926. Three new helminths. *Transactions of the Royal Society of South Africa*, 13, 291-298.
- MÖNNIG, H. O., 1928. Check list of the worm parasites of domesticated animals in South Africa. *13th and 14th Reports of the Director of Veterinary Education and Research, Department of Agriculture, Union of South Africa*, pp 801-837.
- MÖNNIG, H. O., 1932. New strongylid nematodes of antelopes (Preliminary notes). *Journal of the South African Veterinary Medical Association*, 3, 171-175.
- MÖNNIG, H. O., 1933. Wild animals as carriers of nematode parasites of domestic animals. Part III. *Onderstepoort Journal of Veterinary Science*, 1, 77-92.
- NEITZ, W. O., 1931. Blood parasites of game in Zululand. Preliminary report. *17th Report of the Director of Veterinary Services, Department of Agriculture, Union of South Africa*, pp 45-60.
- ORTLEPP, R. J., 1961. 'n Oorsig van Suid-Afrikaanse helminte veral met verwysing na die wat in ons wildherkouers voorkom. *Tydskrif vir Natuurwetenskappe*, 1, 203-212.
- RANSOM, B. H., 1911. The nematodes parasitic in the alimentary tract of cattle, sheep and other ruminants. *Bulletin of the Bureau for Animal Industry, United States Department of Agriculture*, 127, 1-132.
- REINECKE, R. K., 1973. The larval anthelmintic test in ruminants. *Technical Communication, Department of Agricultural Technical Services, Republic of South Africa*, No. 106, iii + 20 pp.
- REINECKE, R. K., 1983. Veterinary helminthology. Durban and Pretoria: Butterworths.
- ROUND, M. C., 1968. Check list of the parasites of African mammals of the orders Carnivora, Tubulidentata, Proboscidea, Hyracoidea, Artiodactyla and Perissodactyla. *Technical Communication of the Commonwealth Bureau of Helminthology*, 38, vi + 252 pp.
- SKRJABIN, K. I. & SPASSKI, A. A., 1963. Essentials of cestodology. Vol. I. Anoplocephalate tapeworms of domestic and wild animals. Jerusalem: The Israel Program for Scientific Translations.
- SMITHERS, R. H. N., 1983. The mammals of the southern African subregion. Pretoria: University of Pretoria.
- VEGLIA, F., 1919. (I vermi parassiti negli animali del Sud-Africa). *Annali della Reserches Accademia de Agricoltura di Torino*, 62, 16-38. (In Italian).
- VERSTER, ANNA, 1969. A taxonomic revision of the genus *Taenia* Linnaeus, 1758 s. str. *Onderstepoort Journal of Veterinary Research*, 36, 3-58.
- WARDLE, R. A. & McLEOD, J. A., 1952. The zoology of tapeworms. Minneapolis: University of Minnesota Press.
- YEH, L.-S., 1959. A revision of the nematode genus *Setaria* Viborg, 1795, its host-parasite relationship, speciation and evolution. *Journal of Helminthology*, 33, 1-98.
- YORKE, W. & MAPLESTONE, P. A., 1926. The nematode parasites of vertebrates. London: J & A Churchill.